

1982

# A Curriculum for Training Extension Professionals in Energy Conservation Education.

Daniel Fontenot Jr

*Louisiana State University and Agricultural & Mechanical College*

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**Fontenot, Daniel, Jr.**

**A CURRICULUM FOR TRAINING EXTENSION PROFESSIONALS IN  
ENERGY CONSERVATION EDUCATION**

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A CURRICULUM FOR TRAINING  
EXTENSION PROFESSIONALS IN  
ENERGY CONSERVATION EDUCATION

A Dissertation

Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Doctor of Education

in

The Department of Extension and International Education

by  
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May 1982

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## ABSTRACT

Energy conservation is a relatively new educational program for the Cooperative Extension Service (CES). The shortage of training programs available to CES in energy education makes it difficult to properly prepare agents for energy conservation work. The purpose of this study was to develop a curriculum for in-service training of agents engaged in energy education. The procedure for achieving this purpose was used to identify the following:

Fundamental concepts necessary for energy conservation education.

Agents' knowledge level of these concepts.

Agents' perceived need for these concepts.

Agents' training requirements.

Through a mail questionnaire selected agents from 20 states were asked to indicate their knowledge level of 24 concepts and the need for including the concept in a training curriculum. The training requirement or gap was calculated by subtracting the mean need rating from the mean knowledge rating for groups being compared. A comparison was made of the different groups' response in the disciplines of heating, ventilating, air conditioning, and buildings; economics and management; home economics and comfort; agriculture and transportation; and thermal science.

The relative importance of disciplines was determined by comparing their mean ratings. An analysis of variance using the F test was used to measure statistical significance.

A comparison of knowledge, need, and gap was used to develop the curriculum based on agents' evaluations of energy related disciplines. The study revealed that training requirements varied when agents were grouped by age, sex, educational background, geographic region, work assignment, tenure, and amount of worktime in energy.

Extension employees working in the field of energy conservation education can receive the proper training to improve their job competence by acquiring knowledge on the concepts in the suggested curriculum. Users could best fulfill the learning experiences proposed in the teaching plan by recognizing and compensating for individual differences in training requirements, knowledge level, and need. The curriculum is general and flexible enough to allow adjustments of training to meet the expressed training requirement of the individual or group being considered.

## Chapter I

### INTRODUCTION

The Cooperative Extension Service (CES) has always had a concern for energy conservation work in its regular program, but not until the 1970's, the decade of the energy crisis, was a need established to emphasize energy conservation planning in Extension programs.

Leedom (25), in her review of energy research, stated that the energy shortage was not perceived in the United States until 1973-74, when the international oil crisis, long gas lines, and rationing at the gasoline pumps became a reality. While the Arab oil embargo did not cause the energy problem, it did demonstrate that a problem existed in the United States.

Clinard and Collins (8) in their energy study found that the energy shortage was caused by patterns of consumption and use of nonrenewable resources. They stated that America is a high-energy society, consuming more total energy than any other country in the world. On the average, U.S. citizens consume seven times more energy than other world citizens. This high demand, coupled with the fact that America's energy supply is based largely upon dwindling fossil fuels, clearly poses a problem for the nation.

In their findings, Clinard and Collins (8) asserted that conservation had been proposed by energy experts as a time-buying strategy to keep the country from exhausting its fuel supply before alternative energy sources can be developed. Since many experts



predict a lead time of 25 years before these alternatives will be ready for widescale use, it seems clear that - for this generation at least - conservation needs to become a way of life. Canfield and Sieminski (6) concluded that conservation would be a responsible beginning toward development of a realistic solution to the energy situation, rather than a postponement of an inevitable disaster. Until an unlimited and inexpensive source of energy becomes a reality, conservation appears to be the best alternative available to help solve the energy crisis.

Because energy conservation is so necessary, and since the CES is proficient in disseminating practical, useful, and current information to the people, the logical conclusion can be drawn that energy conservation should be included in its teaching program. In fact, an article in Extension Review (Summer, 1980) (39) summarizes a report from Congress suggesting that CES address critical national concerns such as energy conservation, which is considered one of the nation's most serious problems. The report attributes the following achievements to CES:

Ten percent of the adult population have participated in home economics and nutrition programs.

More than four million youth have participated in one or more 4-H activities.

Extension Community and Rural Development programs have served about ten percent of the sixty million people of rural America in the roles of educator, catalyst, conveyer, and coordinator.

However, the report states that with national concerns as

serious as energy, the adequate coverage of these issues and problems by CES is being questioned.

In assessing the trends that CES establish or endorse areas of work never before given priority, the Extension Committee on Organization and Policy (ECOP) established a task force on accountability and evaluation. The Committee was to identify critical issues of study. Of interest to the current study was the recommendation that energy programs continue on a wider, more intense scale.

The Residential Energy Conservation Program (RECEP), conducted by CES in 1978, was the first major educational effort stressing energy conservation. The study consisted of practices related to home heating and cooling, home appliances, and driving habits. Verma (45), in assessing the effectiveness of CES educational achievement with the RECEP program in Louisiana, stated,

The adoption of energy-saving practices was fairly high. Nearly one-fourth to one-half of the participants indicated that they had been observing at least one or more of the energy-saving practices before their entry into the program. Participation in CES programs increased this range to between 70 and 90 percent, showing that the educational program almost doubled adoption levels."

RECEP was funded through a national program titled "State Energy Conservation Plan" (SECP). Funds were handled through the Department of Energy. The SECP program was nationwide and each state developed and administered educational programs geared to meet its energy conservation needs.

In 1978, Congress designated 10 states to conduct an energy pilot program. The pilot program, called the Energy Extension Service

(EES) emphasized energy conservation. Following the program, EES was established nationwide. The programs were conducted by CES or other state agencies, and the methods by which the states organized them varied considerably.

The targeted audience of EES was the same one CES had worked with previously; hence, CES could easily accomplish the objectives of the program. Educational programs were conducted by specialists, energy agents, and other professionals at county and area levels.

As reported in the Extension Review (39), Extension agents are very proficient in providing information to people. However, Extension agents have traditionally been recruited primarily from academic disciplines in agriculture or home economics and usually do not have the necessary training for energy conservation work. A study was conducted by Wert (46) to determine training needs of CES workers. His study revealed:

Ninety five percent of Extension staff indicated that they were inadequately trained to provide energy services to clientele.

Most Cooperative Extension staff wanted training on conserving energy in buildings (old/new). They also wanted program-planning assistance from energy program planners or specialists.

Seventy percent of Extension staff indicated that energy backup and university-based technical assistance were inadequate.

Fifty percent of Extension staff indicated that one person in each county office should be designated as "County Energy Coordinator."

In 1914, Congress passed the Smith-Lever Act creating the CES to provide assistance to the agriculture and home economics sectors of our nation. However, in 1980, Congress amended the act to include energy conservation, directing CES to provide more information to the people in energy education.

### The Problem

Energy conservation is relatively new to CES when compared with other areas of Extension work. Consequently, many Extension professionals do not feel qualified to perform energy related work.

Concomitant with the competency problem of Extension workers is an attitudinal issue. Although the importance of energy conservation programs has been recognized and expressed by agents, supervisors of staff personnel, and administrators in the Extension Service, a dissenting attitude on the part of some agents toward the energy conservation program exists. This negative attitude is influenced to a great extent by experience, tradition, and aversion to change. Understandably, agents proficient in disciplines foreign to energy conservation are reluctant to stray from their field of expertise to an area of work in which they have little knowledge.

While immediate attitudinal changes cannot be expected, cognitive ability can be enhanced through participation in properly designed and implemented in-service training programs. Presently, there is no established curriculum for training programs to meet the cognitive needs of agents doing energy work. In order for agents to become competent in energy conservation and more capable of performing their jobs on a professional level, adequate in-service training programs must be developed. A real need exists, accordingly, for a curriculum which would provide Extension agents the opportunity to learn principles, technology, and skills required to be proficient energy conservation educators.

The objective of this study is to develop an in-service

training curriculum for Extension workers engaged in educational programs on energy conservation. The curriculum will give agents an understanding of broad principles about energy conservation so that they may comfortably work in this field of education. The training should be accomplished in a reasonable length of time, not exceeding three weeks. The assumption is made that the agents being trained will have the necessary discipline in Cooperative Extension Service philosophy.

Since training time is limited, and the scope of energy conservation is too extensive to be completely covered, the author will attempt to develop a curriculum containing only the most essential concepts of this area. The study will deal primarily with subject matter related to energy, using a curriculum general enough to allow each state adequate flexibility in selecting or altering the subject matter to meet regional requirements.

Because of the time factor involved, instruction is intended to be given in short courses or training sessions, directed toward giving agents a fundamental background in the principles and technology needed to comprehend technical material and jargon, to evaluate products related to energy and energy conservation, and to review operational and management practices affecting energy consumption. Elements of the curriculum will be based on the cognitive needs of Extension professionals as determined by survey. The fundamental nature of the curriculum lends itself to either direct adoption or modification to fit any state's particular requirements.

### Objective of the Study

The objective of the study was to develop a curriculum for in-service training of Extension professionals assigned energy conservation work.

To accomplish the objective, the following steps are employed:

1. Identification of the necessary concepts for energy conservation work.
2. Construction of a conceptual framework based on the identified concepts.
3. Development of a role model for the job of Extension professionals assigned to energy conservation work as a basis for establishing educational objectives.
4. Development of educational objectives based upon concepts which Extension agents and specialists identify as necessary in energy work.
5. Evaluation of the present cognitive ability of Extension workers in energy.
6. Identification of the training requirements for Extension professionals assigned energy responsibility by comparing training needs to cognitive ability.
7. Design of a curriculum for in-service training of Extension workers assigned to energy work.

## Chapter II

### LEARNING AND CURRICULUM DEVELOPMENT

Learning is essentially the ability to gain knowledge and skills necessary to bring about a change in behavior. However, psychologist Thorndike (40) and others have long discussed learning in terms of stimulus/response relationships and information feedback reinforcers. Most educators express different meanings of the concept of learning. Learning in the psychological sense involves a relatively permanent change in a response as the result of exposure to a stimulus, with feedback providing information to the learning about his change in behavior.

Knowles (23) states that learning is the acquisition of information and the mastery of behavior through which facts, ideas, or concepts are manipulated, related, and made available for use. Flint (12) defined learning as the process of acquiring new knowledge, abilities, or skills. Travers, a psychologist, (41) described learning as "a relatively permanent change in behavior as a result of exposure to conditions in the environment." Although this last definition of learning places emphasis on observable events, the actual learning process lies within the learner and cannot be observed directly. However, evidence that learning has occurred can be obtained and measured.

Learning and behavioral change have been used synonymously by behavioral scientists. Gagne (15) defines learning as "a change in

human disposition or capability, which can be retained and which is not simply ascribable to the process of growth." Hilgard and Bower (18) identify learning as

the process by which an activity originates or is changed through reacting to an encountered situation, provided that the characteristic of change in activity cannot be explained on the basis of native response tendencies, maturation, or temporary states of the organism.

Tyler (42) describes learning in simpler terms, stating that learning occurs when the learner begins to think, feel, or act in different ways, and that satisfaction must be obtained from the change in behavior if learning is to be permanent. Behavioral change may be overt or readily observable, as in learning a skill, or it may be covert and not easily discernible, such as a change in cognitive ability or attitude. For learning to occur, however, the change in behavior must be permanent and not a result of normal biological development.

Eight major categories learning have been identified by Gagne (15) and others as:

1. Signal learning
2. Stimulus/response learning
3. Chain of behavior learning
4. Verbal association learning
5. Multiple discrimination learning
6. Concept learning
7. Principle learning
8. Problem-solving

Each category has a special relationship to the others and cannot be viewed as a separate unit. The simple types of learning,



beginning with signal knowledge, must be achieved before the more complex form such as problem solving can be mastered. This author's research is at the level of concept learning and how it relates to curriculum development.

### Concept Learning

According to Knowles (23), a concept is the common meaning of something. Flint (12) states that we need to have a common understanding of what we are talking about. "A concept is a category within which objects or events are treated as equivalent," is the way Travers (41) defined it. Francois (13) points out that a concept is a product of thought, a construct unique to each individual. He further states that concepts themselves cannot be communicated directly, yet verbal description and visual representations of concepts can be organized to aid in their communication. Thus, most educators cannot agree on the definition of a concept but will accept that it is a common understanding or meaning of something. Concept in this study is used in a sense as defined by most educators, but more specifically in the context used by Pesson (30) and Klausmeier (21).

Pesson (30) links concepts with disciplines. He maintains that disciplines are composed of a series of interlocking concepts which provide a framework for thinking about the phenomenon to be explained. He defines concepts as

ideas which, when utilized enable a person to think about the things in question . . . tools for thinking and learning which are open-ended in nature . . . basic notions which help to explain a phenomenon.

Ryden (35) implies that scholars have difficulty in agreeing upon a

definition of concept. He defines concept as "the label for a set of things that have something in common." He concludes that concepts can be identified, named, and transferred. Klausmeier, et. al. (22) described concepts as "ordered information about the properties of one or more things - objects, events, or processes that enable any particular thing or class of things to be differentiated from, and also related to, other things or classes of things."

Five assumptions concerning the meaning of concepts were offered by Frutchey (14). First, they must be cognitive and applicable in a number of situations in order to be conceptual. Second, they must have structure or function, with structure referring to an abstract shape or form, and function showing use of action. Third, concepts and their subconcepts comprise an individual's cognitive map; they are part of what a person knows and how he organizes knowledge to facilitate thinking. Fourth, concepts must have names and meanings. Frutchey mentions that a given concept can take on different meanings. Last, an individual can possess various degrees of knowledge and understanding of concepts.

Gagne (15) associates conceptual learning with multiple discrimination learning. He describes concept learning as the tool used for thinking in every-day association, allowing an individual to respond to things or events as a class, but states that before a person can respond, he must be able to identify or discriminate among things or events in the class components - a process known as multiple discrimination. He further indicates that the individual can generalize or extrapolate the acquired concept to other different

situations that have not played a part in the learning itself without being prompted and/or acquiring new knowledge. He is able to manipulate concepts and ideas into principles useful in the problem-solving process. Concept knowledge is a precondition to principle learning and problem-solving learning.

In his approach to cognitive learning, Woodruff (48) contends that the individual progressively classifies stimuli into simple, general concepts, then to larger generalizations, and finally into a comprehensive generalized concept. The process of concept learning, according to Woodruff, can be assembled into the following stages:

1. Perception - In the initial stage, perceptual experiences are formed.
2. Conceptualization - Accumulated perceptual experiences grow into concepts.
3. Thinking - Each new mental picture is checked against existing ones and worked into the intellectual process.
4. Evaluation - At this stage the mental pictures are evaluated to select possible alternatives.
5. Choosing - Finally, a choice is made which will produce the desired results.

#### Usefulness of Concept Learning

Concept learning promotes learning effectiveness and advances the practical application and utilization of knowledge. Gagne (15) contends that the acquisition of concepts in the concept learning process makes instructions possible and enables people to think and communicate with one another in a universal language. Thus, the

individual is free from the physical environment and is able to separate ideas and unite concepts into significant principles used in problem-solving. Klausmeier and Goodwin (21) assert that retention and transfer of information may be more effective when the learner shares in discovering the nature of a concept and its application.

In professional education, Tyler (43) states that the person has to be helped to build and understand concepts that are useful in guiding his own thinking about any process or content area. He emphasizes that understanding the concept is much more useful to the individual because of its permanence when compared with fact learning which occurs in rote memorization. Tyler feels that the conceptualization of learning as simply acquiring specific habits is not enough; a concept of education must be fulfilled for a person to carry on a job which will be changing. A person will progress to the point of being able to modify these concepts as he moves along in the light of new knowledge and acquires new experience.

Carter (7), attributes orienting learning around the idea of open-ended concepts. The concepts become tools for adding details and experiences so that they are continually refined and developed, thus becoming increasingly useful.

### Cognitive Learning

The most commonly used definition of education is the process whereby desirable changes in human behavior are produced. The changes sought are pertinent to education because a clear picture of the goals to be achieved must be perceived before the educator can determine the strategy to be used for attaining the identified objectives. Bloom

(2) classified changes into three domains: (1) changes in cognitive or knowledge recall, (2) changes in psychomotor skills and ability, and (3) changes in affective values as they relate to thinking, acting, and feeling. He also categorized cognitive behavior into a hierarchy with knowledge as the lowest level of cognition, followed by comprehension, application, analysis, synthesis, and evaluation, depicting the higher levels. The hierarchy is used to guide educators in defining more precisely the cognitive behavior to be sought. An explanation (2) of each level follows:

Knowledge involves the recall and recognition of information, and includes primarily the psychological process of remembering. The process involves little more than bringing to mind the appropriate material.

Comprehension, the second level in the cognitive domain, represents the lowest level of understanding. Understanding is one step beyond the recall of knowledge, where the individual knows what is being communicated and can make use of the idea being disseminated. This process involves thinking with understanding and the ability to extrapolate.

Application is applying an idea to a new situation. This permits the application of new concepts to new and different situations. The abstractions may be general ideas, rules or procedures, or generalized methods, or they may be technical principles, ideas, and theories which must be remembered and applied.

Analysis perpetuates the upper level of cognitive thinking and behavior. The process lends itself to breaking down complex

communication into ideas which can be expressed in explicit terms. In essence, analysis is the ability to take a new problem area and systematically subdivide it into component parts to make an idea clear and definite.

Synthesis is the process of receiving several complex ideas and placing them together into one workable plan. This system includes connecting elements and parts to produce a clear structure that was not previously seen.

Evaluation includes the judgment as to the usefulness of the plan, or simply to determine what kind of job was done. Quantitative or qualitative judgments are rendered as to the value of substance and methods employed to accomplish the stated purpose.

#### Appraising Cognitive Ability

Evaluating the cognitive abilities of learners in formal educational environments has been the subject of years of research, resulting in standardized testing procedures and material. The formal structure of most educational organizations such as schools and colleges and the homogeneity of students facilitates the use of standardized evaluation procedures and materials and allows the effective use of standardized testing instruments. However, in informal settings, particularly in adult education, evaluation of cognitive ability is more complicated. The heterogeneity of the clientele, the informality of instructions, and the variety of learning situations make it difficult to develop standards for testing.

Limited research has been done on evaluating the cognitive ability of Extension professionals. Verma (44), in his 1971 study,

provided a practical and useful methodology for evaluating the cognitive abilities of education professionals operating in an informal environment. He modified Bloom's classification of cognitive behavior to measure cognitive ability on various disciplines or concepts. The main achievement of the study was the synthesis of relevant features of curriculum and learning theory, and the development of a conceptual framework model for assessing the cognitive needs of Extension professionals in the area of dairy science.

Francois' (13) study dealt with measuring the cognitive ability of Extension agents in community resource development (CRD). Cognitive ability was measured at the knowledge level and at a higher cognitive level. Francois' research revealed the following:

the average overall score attained on test items associated with each discipline concept was 58 percent.

mean scores were generally higher for the knowledge level of cognition when compared to a higher cognitive level.

no significant relationship was found between cognitive ability and age and tenure.

no significant difference was found in cognitive ability between agents designated as full-time in CRD and those with CRD as a secondary responsibility.

agents with undergraduate degrees in home economics possessed a lower level of cognitive ability than the agents with academic backgrounds in agriculture and related fields.

area agents and county agents had equal cognitive ability in CRD as did agents located in rural and urban areas.

Research by Sappington, et. al. (36) in a closely related field, evaluated the importance of the Extension professional's task in an informal educational setting, to help develop a curriculum model for youth workers. The curriculum was directed toward improving the

competence levels of 4-H professionals at the county level. However, this study did not attempt to evaluate cognitive ability and was limited to rating the importance of a task.

Kelley (20) evaluated cognitive ability in a study of male physical education teachers in Pennsylvania. The purpose of the study was to define and ascertain the extent of knowledge obsolescence among physical education teachers. The testing instrument was a multiple choice examination of five subject-matter areas in the field of physical education. This evaluation technique, used in a formal evaluation posture, is readily adaptable to the evaluation of cognitive abilities of professionals working in informal educational settings.

Changes in learner cognitive ability were measured by Boone and White (4) in a study appraising behavioral changes in youth. The research gauged cognitive ability or beginning knowledge to retained cognition through pretest and posttest scores on nutrition behavior. This study would be applicable to access cognitive ability for professional workers, even though it originally dealt with clientele comprehension behavior.

Extensive research is available on the evaluation of cognitive ability of Extension clientele. The majority of studies involve the retention of knowledge over a set period of time. Verma (44) mentions multitudinous studies in this field. He states that, " . . . test procedures adapted in these studies consisted of series of subject matter questions designed to elicit knowledge recall or recognition." The tests were administered in formal groups, as with 4-H members, or by means of personal interviews.



In another study, Bradford (5) attempted to evaluate the full range of cognitive abilities as classified by Bloom, although he preferred to designate these intellectual processes as knowledge. The basic criterion of knowledge tested in most of these studies was the ability to recall or recognize information previously learned or taught during the study.

In addition to the classification in the cognitive domain Klausmeier (21), Simpson (37), and Krathwohl, et. al. (25) developed, classified and offered dimensions for psychomotor and affective behavioral changes. Since this study focuses on the cognitive aspect, no further consideration will be given to the psychomotor and affective domains in this review.

#### Curriculum Development

In 1950, Tyler (42) outlined a way of viewing curriculum development as a functioning instrument of education. He submitted a rationale that begins by identifying four fundamental questions which he felt must be answered in order to develop a curriculum. These are:

- (1) What educational purposes should the school seek to attain?
- (2) What educational experiences can be provided that are likely to attain these purposes?
- (3) How can these educational experiences be effectively organized?
- (4) How can we determine whether these purposes are being attained?

The solutions to these questions provide the rationale for a

person to think through the problem in an organized, practical, and effective manner so that the desired educational objective may be accomplished through the training process. The analysis dictates conditions for formulating educational objectives to satisfy learner and societal needs. Pesson (30) states that the approach

enables one to take the various parts of the curriculum process and put them into an integrated whole, thus forming a conceptual map within one's mind that can be used as an intellectual guide to behavior as a professional in the field of education.

The model provides guidelines for selecting and organizing learning activities which will achieve the educational objectives. Self-correction through evaluation of the extent to which objectives are accomplished is inherent in Tyler's evaluation process.

Tyler intended his model to be used in formal school curricula, but Pesson states that the format enables the Extension professional to think constructively about the design, execution, and evaluation of educational programs. Francois (13) concluded that the model represents a tested and proven procedure for the development of Extension educational programs as well as formal curricula. The Tyler model includes the necessary ingredients that this researcher needed and used to develop a curriculum for in-service training of Extension professionals in energy.

### Origin of Educational Objectives

Educational objectives are the main components in a model for curriculum training. Objectives, when properly stated, permit adequate and precise evaluation of behavioral change and provide a foundation for selecting learning activities, materials, and instructional methods.

Tyler (42) listed three main sources for determining objectives: (1) studies of the learners themselves, (2) studies of contemporary life, and (3) suggestions from subject-matter specialists. Knowles (23) stated that three sources of educational objectives are: (1) individual needs, (2) organizational needs, and (3) community needs. Pesson (30) identified three sources of educational objectives as: (1) the learner, (2) the job, and (3) the discipline. Like Tyler, Knowles, and Pesson, Baker and Popham (106) feel that learning abilities and interests should be given prime consideration in the development of objectives. They maintain that "learners should be involved in the selection of educational objectives."

Examining the learners themselves is the logical place to begin identifying needed changes in behavioral patterns of the students which an educational institution is seeking to produce. Comparing information about the learner with desirable standards, or norms, will reveal any discrepancy between them. This discrepancy is viewed as the need, and more commonly referred to as a "gap," by Knowles (23). He further defined need as the "gap" between "what is" and "what could be" or "what is desired." This meaning of need is different from that defined by psychologists who view needs as tensions which must be brought into balance to improve the welfare of the human organism.

The investigation of contemporary life also gives direction to the selection of educational objectives. Because of an ever-changing society and the complexity of life situations, educational efforts need to be directed to affairs of contemporary significance. The job focuses on experiences and real-life situations of the learner, making the goals more realistic and attainable.

### Educational Objectives in Curriculum Development

Numerous educators have written about the importance of stating objectives carefully so that instructions can be directed toward the improvement of the educational curriculum. McAshan (28) defined an educational objective as having an identifiable goal which recognizes the learner and the outline, implying some type of learner behavioral change that can be evaluated as a direct outcome of the goal. Tyler (42) professed that stated objectives serve as a measure by which content is selected, instruction is planned, and evaluations are conducted. His process includes evaluation while instruction is in progress, as well as assessment of how skillfully and completely the objectives have been attained at the conclusion of the course. This method of evaluation was classified as summational.

Mager (26) and Gagne (15) looked at objectives and were interested in the formative evaluation process which accentuates the "why," rather than whether an educational program succeeds or fails. Their model describes an intended result of instruction instead of the process of instruction itself. The style permits improvement of the instructional package while it is in the developmental phase and avoids the necessity of introducing radical changes into a completed program. Gagne (15) in his model goes on to prescribe detailed methods for measuring behavior and evaluating the students' ability to perform the task. Tyler's style is different because it does not require the specificity which Gagne engages in in his description of each small step in the teaching program. The features of both styles that educationists find useful in describing educational objectives are:

- 1) the inclusion of the kind of behavior which the learners are to acquire, 2) the content with which the behavior is to be employed, and 3) the learner for whom objectives are intended.

Tyler's theoretical model for curriculum development provides the framework for analyzing problems rather than providing "pat" answers needed to solve them. The strength and value of Tyler's model was expressed by Goodlad (16) who asserted that Tyler put the capstone on one form of curriculum inquiry, but at the same time saw a need for theory building through the construction of conceptual systems. The model represents a tested and proven procedure for the development of Extension educational programs including in-service curricula for training Extension professionals.

#### Screening Educational Objectives

According to Tyler, educational objectives must be screened to eliminate those that are insignificant and contradictory and to insure that they are distinctive and consistent with the (1) philosophy of the professional organization, and (2) the psychology of learning. The philosophical criterion refers to the basic beliefs of the organization - the educational and social philosophy to which the institution is committed. Screening objectives will eliminate those that are inconsistent with the goals and philosophy of the institution.

The second screen through which suggested objectives should be passed is for their psychological defensibility. Are objectives timely and achievable? This is a question that should be pondered before making a judgment about the suitability of the objectives.

When formulating objectives for this study, the author selected

only those that were consistent with: 1) program of work of the Cooperative Extension Service and 2) Extension professionals' needs and interests in energy education.

Educational objectives indicate the end product of learning. The end result must conform with conditions that are fundamental in learning. That is to say, the material must be pertinent, timely, and feasible in order for learning to take place. Selecting only as many objectives as the student will have time to learn should be given prime consideration. Learning takes time and practice, so a limited number of achievable objectives which are consistent with the philosophy and the time available is essential. For these reasons the curriculum that the author has developed was limited to a three-week training period, with only the most essential disciplines included.

#### Stating Educational Objectives

Tyler (42) emphasized that the real purpose of education is not to have the instructor state what he plans to do, but rather to bring about stipulated changes in students' patterns of behavior. Educators should recognize that any statement concerning objectives needs to emphasize the desired change in the student and not the need of the school. Gronlund (17) expressed a preference for stating objectives with a behavioral aspect so that the proper learning action would be selected, facilitating the instruction process to be judiciously administered. Most of the authors agreed that the three main elements for stating educational objectives are the learner, content, and behavioral changes desired.

Concept learning facilitates education because it permits understanding of instructions and enables the learner to think and communicate with others in a universal tongue. Standards for teaching in the formal educational setting have long been established. Research on evaluating cognitive abilities of adult educators in informal circumstances has been limited because of general complexity, the heterogeneity of audience, the informality of instruction, and the varied learning situations.

Tyler's curriculum model provided the framework on which this study was developed. The training need and cognitive ability of Extension professionals regarding concepts related to job assignments in energy education were used. The measure of cognitive competence in this study indicated the needed educational objectives for the in-service training curriculum developed in energy education. The author focused his research on the informal type of training because such a training program was non-existent.

#### Selecting and Designing Learning Experiences

After the objectives of an educational program have been specified, it is then possible to plan solutions to achieve the goals. The learner must experience the learning in order for learning to take place.

The learning experiences are selected to help the learner practice the behavior implied in the objective. The learning does not take place from an exposure or presentation of information. The learner must be able to participate or do the things he is to learn. Pesson (30) states that the problems, then, of selecting and designing

learning experiences are to determine the kinds of experiences which are apt to produce the desired change(s) and to set the climate of the learning situations in such a way that each student may grow and develop the behaviors.

### Organizing Learning Experiences

The organization of learning experiences must be designed so that the learner will be reinforced throughout the curriculum training process.

Tyler (42) lists three major criteria that can be used to judge curriculum organization. These are 1) continuity - refers to the vertical reiteration or recurring and continuing opportunity to use the major behaviors to be developed in the curriculum. 2) Sequence - the progressive development of the desired behaviors. With each sequence of learning new progressive dimensions must be added to the learning process. 3) Integration - the horizontal relationship of learning experiences. Various training experiences of the curriculum may be unrelated, but they should fit into the learner's conceptual map with agreement and usefulness.

### Evaluation

One of the most important concerns in curriculum development is to determine whether the educational objectives are being attained. An evaluation will ascertain the extent to which the specified goals for the curriculum have been accomplished.

Bloom, et. al. (3) list two types of evaluation, formative and summative. Formative evaluation is the process used to guide learners



in achieving objectives. The process should answer questions such as, to what extent learning experiences are being attained as viewed by the person doing the teaching. The process includes an appraisal which occurs at each major step during the execution of the curriculum.

Summative evaluation differs because it deals only with the end-result. In other words, the evaluation is not continuous but results from the completion of experiences in the curriculum.

### Chapter III

#### ENERGY CONSERVATION

Extension clientele will eventually be the beneficiaries of the knowledge acquired by Extension professionals on preventing waste and utilizing energy to its most advantageous purpose, while taking into account cost-effective measures for reducing the need for energy. The ultimate goal of energy conservation is saving money for clientele and improving or maintaining present lifestyles on a budget that people can afford.

The definition of energy conservation as used in this study, is the wise and efficient use of energy. This study will identify the the energy concepts necessary for Extension professionals to:

1) evaluate energy conservation products and practices, and 2) teach energy conservation to Extension clientele.

While the importance of energy conservation is widely acknowledged, a brief review of writings, history, and implications concerning energy conservation is appropriate. In a paper presented at the Annual Conference on Community Colleges, Riendeau (34) made positive statements suggesting directions for conserving energy, but at the same time he raised questions concerning major areas where conservation is greatly needed. He stated that,

reducing energy consumption will call for cooperative participation at all levels of government and by people in all walks of life. What is called for is a blend of efforts. Conservation must become a way of life in America. Motorists and home owners, businesses and industries,

schools and colleges--all must be of one mind on the subject of energy conservation. How soon can more power plants be changed from oil to coal? Is public transportation or carpooling adequately encouraged for the community work force? Is the auto industry shifting to gas economy cars fast enough?

The energy crisis was first perceived during President Ford's administration when the oil embargo of 1973 created the first serious energy shortage in the United States. In his study, Riendeau quoted Ford in a speech to the nation as saying:

I ask each of you to apply our most abundant natural resource--American ingenuity--toward including energy conservation in your life. This goal is not to change our standards of living, but to ensure that as we enjoy our American way of life, we are not wasteful and that we use our energy resources wisely. Each person has a part to play in this effort. I ask each of you to play your part.

Because of the low cost of energy in past years, energy conservation was not a high priority. From 1950 to 1970, the U.S. Gross National Product doubled in constant dollars, and total energy consumption increased at the same rate. Electricity consumption quadrupled during the same period. Since the population increase was only 40 percent, a large part of the increase was in per capita energy consumption.

Duggan (9) predicted that the amount of energy that Americans would use would double every 10 to 15 years. This 10 to 15 years doubling time also means that this nation will need in the next 10 to 15 years or each doubling period as much energy as we have used in the history of mankind. Continuing to appraise the energy status he said,

In the 1940s and 50s the United States was the greatest supplier of oil to the world. In 1953 we supplied not only our own needs but half the world's needs. However, in 1961, U.S. oil reserves reached a peak and began to

decline. In 1978 we have not only failed to supply other nations, but indeed we must import half the oil we need for our own use. The United States has based its economy, its industrial machine, and its way of life upon the presumption that oil and gas will remain cheap and abundant. We use 46 percent of the world's oil supplies. That means that every American uses the equivalent of 2,700 gallons of gasoline every year.

Duggan also stated that

the fact that we import oil at the rate of three billion barrels a year has staggering implications. To pay for those three billion barrels of oil flowing into our country from various foreign nations, there is a drain of \$120 million each day leaving this country. This \$45 billion a year that goes to foreign nations has aggravated our balance of payment problem. In fact, our trade deficit is only about \$25 billion, so as someone pointed out, the problems with the dollar are caused less by cheap Japanese televisions than by expensive Arab oil.

The total world supply of oil will be exhausted in 15 years if the rest of the world uses energy at the same rate as Americans. The best predictions are that by 1985, or no later than 1990, the world's oil production capacity will peak at about 80 million barrels a day. If demands continue to increase from that time forward, we can expect to see severe economic and social problems in this country and around the world.

In the spring of 1977, President Carter presented to Congress a daring and controversial National Energy Plan. Nearly a year and a half later, on October 15, 1978, Congress passed the National Energy Act composed of five bills: The National Energy Conservation Act of 1978, the Powerplant and Industrial Fuel Act of 1978, the Public Utilities Regulatory Policy Act of 1978, the Natural Gas Policy Act of 1978, and the Energy Tax Act of 1978.

The purpose of the National Energy Act, according to Energy

Secretary Schlesinger, was to

put into or place a policy framework for decreasing oil imports by:

- 1) Replacing oil and gas with abundant domestic fuels in industry and electric utilities.
- 2) Reducing energy demand through improved efficiency;
- 3) Increasing production of conventional sources of domestic energy through more rational pricing policies; and
- 4) Building a base for the development of solar and renewable energy sources.

The National Energy Act was fiercely debated, but the basic principles of the plan were accepted. Washington administration often referred to the following principles as the "Ten Energy Commandments"

(9) for the development of energy policies:

1. The energy problem can be effectively addressed only by a government that accepts responsibility for dealing with it comprehensively, and by a public that understands its seriousness and is ready to make necessary sacrifices.
2. Health economic growth must continue.
3. National policies for the protection of the environment must be maintained.
4. The U.S. must solve its energy problems in a manner that is equitable to all regions, sectors and income groups.
5. The U.S. must reduce its vulnerability to potentially devastating supply interruptions.
6. Growth of energy demand must be restrained through conservation and improved energy efficiency.
7. Energy prices should generally reflect the true replacement cost of energy.
8. Both energy producers and consumers are entitled to reasonable certainty as to government policy.
9. Resources in plentiful supply must be used more widely, and the nation must begin the process of moderating its use of those in short supply.

10. The use of nonconventional sources of energy must be vigorously expanded.

The cornerstone of the National Energy Plan (9) is energy conservation and improved energy efficiency. At the same time, our nation must make the switch from an oil-based economy to one that makes better use of the other fuels now available . . . we must emphasize energy conservation in order to reduce demand, if we are to weather the peaking and decline of world oil production that is expected in ten to fifteen years. In addition to energy conservation, an increased use of coal and nuclear power seems to be required in the mid term. We will then need to rely to a larger and larger degree on synthetic fuels--for example, gas and liquid fuel from coal--on oil shale, on geothermal energy, on solar heating and cooling and on other exotic forms of energy.

In the long term, after the year 2000, we must make the transition to renewable energy sources, perhaps in the fields of solar electric and fusion energy. These technologies of the next century, however, are neither sure nor are they ever going to be cheap. The transition from a spend-thrift economy based on gluttony of oil and gas to an economy that practices energy conservation, that practices wise energy management, and that makes use of renewable energy sources is not going to be quick or easy.

The National Energy Extension Service Act (47) of June, 1977 established an Energy Extension Service (EES) to provide small energy users with face-to-face technical assistance and information on energy matters. The creation of the Energy Extension Service was a direct response to a recommendation made by the House Committee on Science and Technology following their study of the nation's energy conservation needs. They reported that the provision of a mechanism to connect small-scale energy users with practical energy conservation opportunities was a critical factor in increasing the capability of individuals to make informed energy decisions.

Exxon, in a 1980 publication (11), summarized the world energy outlook as follows:

Despite economic growth rates lower than in the past and despite declining energy/GNP ratios, demand for energy will continue to increase. By 2000, world energy demand could be about two-thirds higher than at present.

The transition to a new energy supply environment will accelerate over the next two decades. Coal and nuclear power will play increasingly important roles, and synthetics will become significant in the years beyond 1990. In all sectors of the economy greater conservation and greater efficiency in the use of energy can be expected.

This transition can be achieved. Some of the required technology is available now and new processes are under active development. Development of energy sources in a timely fashion will satisfy the requirements for expanding energy supplies without seriously infringing on economic growth. Access to the required resources, support for the accelerated development of synthetic fuels, and government policies, especially those concerned with environmental controls, will all affect the pace of the transition and its economic and social consequences.

Mahoney (27), in his report, examined energy-related vocational programs at two-year colleges and discussed the factors to be considered in the future development of energy educational programs. He stated,

The energy situation in this country has been called a crisis legitimately. The Chinese use two characters for the word 'crisis.' One is for danger; the other for opportunity. From the perspective of education, the danger lies in rushing to implement technology programs before there is clear evidence that the graduates are needed. The opportunity lies in expanding our efforts to infuse existing occupational training programs with energy-focused courses, while at the same time providing helpful information to the general population to improve their understanding of the nature of the crisis and to help them make their personal contributions to the solutions.

The local CES county staff, with the aid of local lay advisory committees, determines local program needs. County agents, as they are usually called, are supported by a specialist staff technically trained in a variety of disciplines such as agriculture, engineering, forestry,

home economics, education, health, social sciences, etc. Land-grant universities have appointed special task forces from several disciplines to deal with both research and extension capabilities in energy conservation, as every state Cooperative Extension Service (CES) is providing programs emphasizing those practices which conserve energy in the home, farm, and related businesses.

CES has in recent years played a major role in the planning and execution of community, state, and federal energy programs emphasizing energy conservation. Even though the primary responsibility for directing the National Energy Extension Service Act of 1977 rested with the Department of Energy (DOE), the CES was engaged to carry out the Energy Extension Service (EES) programs in seven of ten pilot states.

The role of CES in energy education can be traced from its inception. Congress passed the Smith-Lever Act in 1914 creating the Cooperative Extension Service to bring to the people useful and practical information on agriculture and home economics and related subjects. The Act (33) was amended by Congress as Public Law 96-294 on June 30, 1980. The main revision was substituting the phrase "home economics, and rural energy" in lieu thereof for "and home economics." The significant change focused on the amount of importance Congress place on energy conservation for rural areas.

The role Extension should play has been recognized by various steering committees. A brief synopsis includes the recommendations made by the Extension Committee on Policy Report, (ECOP) Task Force, Science and Education Administration (SEA), and Energy Research and



Education in Agriculture Committee. The ECOP Task Force that developed a strategic energy plan for SEA (38) reports the following about Extension's responsibilities:

The CES in each state provides education and technology transfer to users. The most important key to the success of the agricultural technology transfer program is the unique Cooperative Extension System in which federal, state, and county governments form a three-way education partnership. This partnership has its roots in more than 3,000 county Extension offices close to the technology users. County Extension agents have direct access to researchers and are supported by highly skilled specialists at the state and federal levels. These state and federal specialists follow new national and international developments within their areas of specialization, synthesize these technologies into practical systems, and work with county Extension agents in developing training programs and providing specific counsel to users of the technological developments. Of the nearly 17,500 professionals in Extension, 3,371 are full-time specialists at the state level. The total number of individuals is somewhat greater, because some specialists devote a portion of their time to other activities such as research.

The Extension program is greatly bolstered by volunteers. A recent inventory revealed that there were about 380,000 members of councils, boards, and committees who participated in planning and conducting programs. Nearly 580,000 volunteer leaders teach and work with more than 5 million youth in 4-H programs.

Education and technology transfer within Extension is further augmented by experienced information specialists and an extensive communications system that reaches users through television, radio, newspapers, and magazines. These specialists work closely with researchers and Extension specialists in developing news releases and in making presentations on television and radio. Of even more lasting significance is the involvement of the researchers and Extension specialists in preparing hundreds of widely distributed popular

publications and in conducting public workshops, seminars, conferences, and short courses.

The Energy Program needs for CES were defined by the ECOP

Task Force (10) as:

1. Each state CES should analyze present and future energy programming needs in light of recent federal-funding changes. This may necessitate establishing priorities and re-allocating more resources and personnel for energy programming.
2. Each state should develop and adopt an interdisciplinary energy program (home economics, agriculture, community resource development, and youth) in which there is administrative commitment of resources and personnel. If CES is going to provide energy education to the public, there should be hard monies set aside, not dependent on pass-through monies, Energy Extension Service monies, or other soft monies.
3. A broad context for energy-related education must be implemented to make its wide distribution effective. Information must be in a form that allows users to make informed decisions appropriate to their own needs and resources, i.e., on the farm, in the home, or community.
4. Each state director should seek commitment from presidents, vice-presidents, deans, and department heads of their college for Extension Energy Programs.
5. Each state should consider increased funding for:
  - a. Conservation/energy management.
  - b. Renewable energy forms.
  - c. Consequences of continuing dependence on non-renewable energy sources vs. the pursuit of energy conservation and production alternatives.

Still another ECOP report (29) stated Extension's role as:

- a. Maintaining an educational role as the primary identity.
- b. Basing recommendations on research from land grant universities - new concepts or technology with the tested adaptability.
- c. Providing continuous interpretation and updating of research with respect to management practices, conservation techniques, and the application of new technology.

- d. Maintaining the principle that technical information must be related to a decision making framework that will enable people to make wise choices.
- e. Developing an in-place information and educational delivery system organized on county, state, and federal levels, reaching households, businesses, and community leaders.
- f. Concentrating expertise and subject matter upon the needs of local clientele.
- g. Working with a defined clientele, distinct by location, vocation, or subject interest.
- h. Programming support, control, accountability exist at the county, state, and federal levels; this decentralization is due to the financial contributions and the involvement of people from these levels of government.

The ECOP Committee reports (29) summarized and made the following recommendations:

Extension's educational role and expertise in teaching management throughout the food and fiber systems and in the home should be reaffirmed. Energy management is part of a larger management problem, and Extension can play a unique role in enabling people to incorporate knowledge of energy conservation into larger management problems. Because of its educational nature, the integrative process often shows fewer immediate results than simple technical development or technology transfer and is thus harder to sell. But this integrative role is as important as any specific technical contribution that Extension can make, and it is particularly suited to Extension.

In teaching management, however, Extension must maintain its independence. Extension's first obligation is to its clients; information must be interpreted and presented so that it is appropriate to their needs and their interests rather than to the individual objectives of a state or federal agency or of private industry.

This ECOP report further suggests a general overview for CES to follow concerning national energy education.

- 1. The subject matter includes technical and policy issues relating to effective energy use and conservation, alternative sources, and social and land use concerns -

such as generating stations and transmission lines - associated with power facilities.

2. All traditional clients need attention. New clients may be reached by broadening the existing program base.
  - a. Given more technical back-up from other areas, households can be reached through programs developed through home economics.
  - b. Small businesses can be reached using models developed to serve agricultural and recreational businesses.
  - c. Youth can be reached through programs developed for 4-H.
  - d. Community leaders can be reached through CRD.
  - e. State leaders can be reached through professional development and public affairs programs.
  - f. Producers, processors, and marketers in the food and fiber system can be reached through existing management and technical transfer programs.
3. All traditional Extension educational methods can be used.

Energy is a new problem area that can be attacked through Extension's traditional strengths using the normal program development process, by reallocating resources, and by adding the necessary new resources.

Program development recommendations (29) were assessed by ECOP committee as:

1. Management of resources: The energy question is not simply a conservation program; education should include, for example, cost/benefit analysis (including non-dollar considerations). Energy education should respond to both individual and societal needs and strive for a balancing of these in government policy.
2. Life habits: Energy education should approach life habits positively, relying on sensitivity of county agents to deal effectively with clients.
3. Land use, environment, and other impact problems surrounding energy facilities must be faced early: Energy education should help citizens identify options and trade-offs and provide appropriate forums for discussion of them.

4. A broad context for energy-related information is essential to make its wide distribution effective. Information must be in a form that allows users to make informed decisions appropriate to their own needs and resources. Awareness and consideration of environmental, economic, and social consequences of decisions must be a part of the educational program.
5. Energy education programs must be comprehensive, including resource conservation, alternative sources, energy management, and new technology as they relate to the food and fiber system, housing and family living, and to the adjustments to be made by families and communities in order to maintain or improve their quality of life.
6. To serve the needs of existing clientele and to reach new clients, Cooperative Extension will have to develop new structural arrangements for reallocating existing resources and for securing additional ones.
7. A system for sharing energy program resources will have to be developed both on the regional level and within the USDA.
8. Cooperative Extension's own energy education role has to be defined both within USDA and with respect to other agencies.
9. Memoranda of understanding that assign authority and responsibility and that allocate resources must be developed when Extension staff work cooperatively with other agencies.
10. If Cooperative Extension is to work successfully on a joint basis with other agencies, it is essential for Extension to be a partner in the planning phase as well as in the implementation phase of any given program.
11. Cooperative Extension must help to identify energy-related research needs, expanding the research base needed to insure Extension's credibility.
12. Cooperative Extension must develop and use:
  - a. Data on program resources committed to energy education efforts (under whatever subject heading).
  - b. An evaluation system to determine the cost-effectiveness of CES programs in terms of the extent to which they meet the needs of the clientele.

13. Cooperative Extension must always take the first step to assure good communications and a good working relationships with other agencies.

Good organization and resource allocation were suggested as being crucial to a sound energy program. ECOP proposed the following plan (29):

1. Internal organization: Recommend a program committee and full-time program coordinator in each state. We do not recommend the creation of a new program but an interpretive and integrative role to be played by the program coordinator.
2. Resource allocation:
  - a. Existing specialists must be made available to help state agencies with program, policy, and material development and to advise on how to use Extension resources.
  - b. New specialized talent is required and may be acquired from:
    - 1) university departments (non-agricultural college) through contract or agreement,
    - 2) private consultants through contract, and
    - 3) state agencies through agreement.

NOTE: Here Extension is active as a broker to pull resources together.
3. A balanced staffing plan is needed: To increase specialist resources to match available delivery mechanisms in county or area offices.
4. State level approaches: May be necessary in some cases, with specialists producing, advertising, and delivering programs. While this approach bypasses the county office (except as a referral point), it offers quick and sure delivery in areas of specialized technical or managerial education.
5. County level approaches: May be necessary to train and designate specific county or area staff for explicit energy-related expertise and/or responsibility.

Delivery of education is not separable from responsibility for content. This requires specialist screening of program information and agent feedback on local needs and receptiveness. Extension cannot simply be a conduit for program material produced by others -

though it can be and should use this material wherever appropriate.

External organization and resource acquisition should be viewed at the state and federal levels as outlined (29):

1. State Level:

- a. Requires Extension (and general university) participation on state-wide policy committees.
- b. Requires full-time program coordination to track developments and to insure early participation by Extension in program planning.
- c. Requires strong ties between Extension specialists and state agency staff members so that Extension can serve agencies through technical consulting, program planning, and project and instructional materials development.

2. Federal Level:

- a. Requires a full-time Extension Service-funded coordinator in Washington
  - 1) to develop appropriate linkages with DOE and others, and
  - 2) to develop professional exchange and staff interaction between Extension Services and agencies outside of USDA.
- b. Requires funding through USDA to allow Extension to develop independent programs best suited to its clientele and to insure appropriate screening and wise use of materials produced by others.

A study by the ECOP Energy Task Force (29), a group composed of state specialists and USDA staff established to assess the current state of energy-related programs in Extension, suggests directions that CES should take and suggests strategies for the implementation of these program-related recommendations. The report presented the following situation statement:

Increasingly, Extension clientele are demanding assistance for energy education and information. At the same time, there is a demand by federal agencies that the energy issue be addressed and that the CES assume a variety of roles.

The Department of Energy tends to see CES as an agent of technology transfer and demonstration - convincing people around the country to invest in the hardware that will save energy. Many state energy agencies see the CES as the delivery link for highly visible personal contacts, enabling state officials to demonstrate and publicize their concern on behalf of the individual citizen. In either case, however, Extension is viewed only as a delivery system. Its value as a unique educational system, which is client-directed and client-critiques, is not recognized.

The CES should decide what its role will be and what clientele it can serve best with energy education. While the federal effort has been to centralize energy concerns and decisions in a specific agency, the CES provides a flexibility of approach which may otherwise be lacking in national programs. In addition, CES is one of the few credible institutions capable of informing clientele of alternatives and the consequences of these alternatives regarding energy management, conservation, and new technology.

Energy research and education in agriculture and the Ad Hoc Committee on Energy of the Joint Council on Food and Agricultural Sciences (19) has identified and examined several major energy issues in American agriculture. In response to these issues, the committee offers the following recommendations:

1. The Secretary of Agriculture should identify energy as a major area of interest and issue a statement of policy outlining USDA energy interest and goals as they affect production and distribution of food, fiber, and forestry production, including land and water considerations.
2. The USDA should seek White House approval to make direct budget requests supporting energy programs related to agriculture and forestry rather than depend on passthrough funds from DOE. The Secretary of Energy should be consulted to coordinate programs with those funded by that agency.



3. The Secretary of Agriculture should establish a departmental Energy Committee responsible to the Director of Science and Education to recommend policy and to coordinate energy programs within the various agencies of the Department.
4. USDA agencies should provide for coordinated research leadership and technical and financial assistance to develop and implement technology to adjust to an era of expensive energy. Rising energy costs have made much of the production technology obsolete because system designs were based on inexpensive petro-energy.
5. The Secretary should support a substantial program directed toward achieving a practical degree of energy self-sufficiency in agriculture and forest production, including the establishment of new administrative linkages with the engineering industry. Further, the Secretary must participate in major decisions regarding allocation of national resources and other factors affecting areas of USDA responsibilities. Specific examples are soil conservation and irrigation agriculture. The Department of Interior's Office of Water Research and Technology (OWRT) program performs a crucial role in the issue of energy in agriculture, and OWRT's future is uncertain.
6. The Secretary of Agriculture should establish a graduate fellowship program to support students in energy-oriented agriculture engineering and wood science programs.

#### Extension's Energy Philosophy

The goal of the CES is to transfer knowledge and timely information empowering people to make wiser decisions concerning themselves, their families and their communities, creating more acceptable and comfortable living conditions for its people.

Pifer (31) relates that

Cooperative Extension staff in more than 3000 Extension offices across the country are responsible for planning and conducting educational programs in cooperation with community leaders and volunteer workers. Specialists, located at the land-grant universities, provide

leadership and backup information to the county or area staff. Specialists and program leaders at the federal level provide national leadership and program coordination among states.

Concerning Extension's philosophy on energy, Pifer wrote,

People must perceive the problem before change will occur. To make changes, people must be better informed about energy resources and the environmental, economic, and social costs involved.

To achieve a slow down in the use of energy and finite resources, families and/or individuals need to better understand and examine their attitudes and values concerning their lifestyle and use of energy and other scarce resources, only then can they make adjustments that are less energy intensive.

Extension's resources have been shifted and additional resources from the Department of Energy and state energy offices have been sought in order to expand programs that have greatest impact on decreasing energy consumption and exploring alternate and renewable energy sources."

#### Future Role of Extension in Energy

The role that Cooperative Extension Service (CES) should follow in assuming its functional responsibilities in energy education is offered in a suggestion found in the USDA publication "Energy Capabilities and Opportunities" (38):

An assured supply of energy for the U.S. food and agriculture system is clearly in the public interest and is a national priority. The Joint Council on Food and Agricultural Sciences (19) identified energy as one of the areas for increased emphasis in the next five years. To ensure orderly progress toward its energy goals, SEA's energy plan should be completed and widely publicized to facilitate understanding of the issues and to generate support.

The primary responsibilities of the publicly supported agricultural system are in the functional domains of teaching, research, Extension, and technical information. Important program elements that

need to be developed for each of the functional responsibilities of SEA are listed below.

Extension's goals concerning energy teaching (39) can best be accomplished with implementation of programs that will:

- Designate a full-time energy Extension program coordinator in each State. This recommendation does not imply a new program area, but rather an interpretive and promotional role.
- Designate the transfer of energy technology and the efficient management of energy as priority programs within the CES. Integrate energy issues associated with the food and agriculture system with those of housing and family living. Given the current serious budgetary stresses, the energy education roles of CES and EES should be clearly defined. To serve the needs of existing clientele and of new audiences, the Extension system may have to develop new structural arrangements for reallocating existing resources and for securing new resources.
- Develop a comprehensive energy-outreach program that will include resource conservation, renewable alternatives, and energy management as related to the food and agriculture system, rural housing, family living, and rural communities and as related to adjustments that families and communities should make in order to maintain or improve their quality of life. A broad context for energy-related information is essential to make its wide distribution effective. Awareness and consideration of the environmental, economic, and social

consequences of actions taken should be part of educational programs.

- Negotiate memoranda of understanding and other agreements that assign authority, responsibility, and funding for cooperative work with other federal, state, and local entities in carrying out energy Extension programs.
- Identify energy-related research needs and communicate those needs to SEA and SAES research personnel.

## Chapter IV

### RESEARCH DESIGN

#### The Research Model

The research model used in the study is an adaptation of the Tyler (43) and Knowles (23) models which provided the framework to identify and explain the procedures required for the development of the curriculum. This model is shown in Figure I with its basic elements and their inter-relationships. The research model was applied to the field of energy conservation for the purpose of developing a curriculum for in-service training of Extension professionals in the work area of energy conservation.

The ultimate purpose of the study was to apply the research model as a conceptual framework to develop objectives for an in-service training program in energy. The basic assumption adopted was that Tyler's concept of need is the most useful and practical indicator of the behavior-content dimensions of objectives. Training requirements were established by evaluating the discrepancy between knowledge level and necessity of the concept for Extension professionals who are engaged in energy conservation work.

Relevant energy concepts, and disciplines were obtained from three sources, namely: 1) discipline, or specialist, 2) job, and 3) learner. Energy publications, energy specialists, and a panel of energy experts provided the conceptual framework in the energy

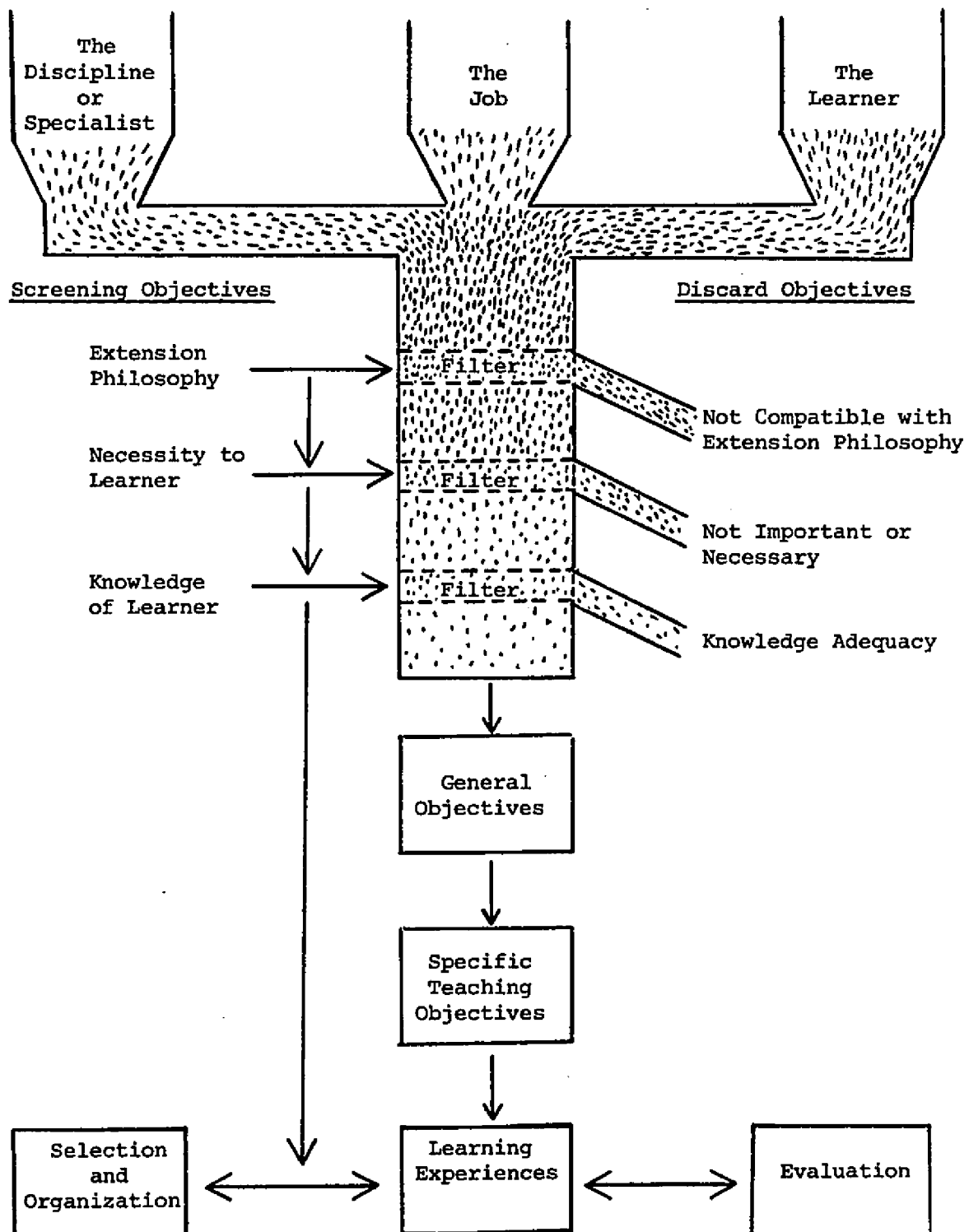


FIGURE I Energy Conservation Education Curriculum Model

conservation education theory which Extension professionals should ideally possess as part of their intellectual repertoire.

The Extension energy specialists at Louisiana State University identified the important concepts that Extension professionals should know concerning energy conservation education. Furthermore, a panel of energy experts comprised of CES energy coordinators from four cooperating states - Florida, Georgia, Louisiana and Pennsylvania - screened the concepts identified by the author and energy specialists for the degree of necessity of concepts to be included in an in-service curriculum for training Extension professionals. Following this process, a questionnaire was developed.

Basic information on need and knowledge were supplied by the learners (Extension professionals). The identified need and training requirements of the learner were the most valuable tools for the construction of the training curriculum.

Cognitive ability was assessed according to the knowledge-understanding criteria recommended by Bloom, Hastings, and Madaus (3) and for including a concept in the curriculum and cognitive ability about the concept established the gap or training requirement. The resulting curriculum, expressed as general educational objectives and supporting concepts, was screened by the author, specialists, and a panel of energy experts to see if it fitted the Extension philosophy, and met the criteria for necessity and knowledge of the learner.

The screen eliminated objectives that were not compatible with Extension philosophy, unnecessary to the learner and those of which the learners had adequate knowledge. The screening procedure produced

a smaller list of general objectives that were consistent with the educational curriculum being developed. Specific teaching objectives were designed to fulfill the need and training requirements in order to achieve the desired behavioral change. The instructor can select the major concepts and learning experiences necessary to meet the training requirement of his clientele. The evaluation determines if the objective was successfully achieved.

### Methodology

During President Carter's term, 10 pilot states - three of which are in the Southern Extension Region - Alabama, Tennessee, and Texas, were selected to initiate energy conservation programs under the sponsorship of the Department of Energy (DOE). The other seven pilot states were Connecticut, Michigan, New Mexico, Pennsylvania, Washington, Wisconsin, and Wyoming. These states along with Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina and Virginia were included in the study. Extension professionals from 20 states - 10 pilot energy states and the 10 states of the Southern Extension Region not among the pilot states were included in the study.

A review of current literature and the expertise of the Louisiana Extension energy specialists provided the basis for selection of disciplines and concepts appropriate to the curriculum. The four energy specialists from Louisiana were asked to list all disciplines and concepts related to their respective specialty in the field of Extension energy conservation. Naturally, the list consisted of many more disciplines and concepts than could feasibly be incorporated



into a workable training program. The inventory was refined, reduced and polished so that the most essential points would be included. The plan was submitted for scrutiny to a panel of experts. The material was prepared in questionnaire form and evaluated by the panel of experts composed of the four Extension energy coordinators from Florida, Georgia, Louisiana, and Pennsylvania. The panel evaluated the concepts and disciplines against the criteria that they were considered essential for Extension professionals to be proficient Extension energy educators. Additionally, the panel was instrumental in adding, deleting, selecting, screening, and evaluating disciplines and concepts.

#### Data Sources

The Director of the Louisiana Cooperative Extension Service requested each of the Extension Directors of participating states to appoint a liaison energy coordinator to supervise and coordinate the research. All states accepted and agreed that the liaison person would assume the following responsibilities within his state:

- Identification of Extension workers who spend considerable time in energy
- Dissemination of questionnaires to energy Extension professionals
- Encouraging respondents to complete questionnaires
- Returning completed questionnaires to the researcher

The 20 energy coordinators identified 179 Extension professionals employed at state and county levels of which 149 (83 percent) responded. However, not all respondents completed the

questionnaire on all variables, limiting the number of respondents available for analysis to those who had given complete information.

### Sampling and Data Collection

Due to the large geographic area and the difficulty in reaching the respondents from a central location, one Extension specialist from each state served as liaison and intermediary in data collection. The population included all Extension professionals in the 20-state area whose assignment called for considerable time devoted to energy education. The responsibility of identifying and selecting respondents was given to the energy liaison coordinator from each state. This insured that a major segment of the Extension professionals doing energy work was included in the resulting sample.

Information was tabulated from questionnaires mailed to Extension professionals in the 20 targeted states. (There is a copy of the questionnaire in appendix.) Section I of the questionnaire contained interrogations about the degree of necessity for including the energy concept in an in-service curriculum for training Extension professionals and solicited the respondent's knowledge level concerning each concept. In column I the participants were asked to give an opinion on the concepts in column II as to the necessity of being included in the training curriculum. The rating scale was as follows: a rating of 4 would indicate very necessary, 3 necessary, 2 somewhat necessary, and 1 little or no necessity.

Column III assessed knowledge level of the Extension professionals in each concept area listed in column II. Knowledge was measured in four stages: 4, representing very knowledgeable;

3, knowledgeable; 2, somewhat knowledgeable; and 1, little or no knowledge. Twenty-four concepts which may be essential to Extension professionals doing energy work were listed in column II. Each concept was defined, including components and/or examples to assist respondents in properly interpreting the meaning of the concept to be included in the in-service training curriculum.

The difference between the knowledge level and the degree of necessity for including the concept in a training curriculum established the need for knowledge or "gap" where energy training is needed. The in-service curriculum to train Extension professionals in energy conservation was then developed from the identified training requirement.

Section II was designed to elicit information on basic personal and professional characteristics such as age, sex, experience in Extension work, energy responsibility, work assignment, educational background, and geographic regions.

#### Analysis of Data

The data provided by Extension professionals through the questionnaire was analyzed in four major dimensions: 1) distribution of personal and job-related characteristics; 2) analysis of knowledge level; 3) analysis of expressed need for training; and 4) analysis of gap between knowledge level and expressed need for training.

Personal and job related characteristics such as age, sex, tenure in Extension and energy work, educational background, work location, and time devoted to the job must be taken in consideration when developing a curriculum. Frequency distribution of these

independent variables was used to specify the audience for whom the in-service curriculum was being developed.

The second part of the analysis dealt with the knowledge level; the third part analyzed expressed training needs and was followed by the evaluation of the gap between knowledge level and expressed need for training in selected energy concepts. The second, third, and fourth part of the analysis dealt with the dependent variables, namely: knowledge, need and gap and their comparison with independent variables, of age, sex, educational background, geographic area, work location, tenure, and work-time in the job. The dependent variables were evaluated for each of the 24 concepts and analyzed in detail for the concepts grouped in five major discipline areas on a four-point scale. Scores for disciplines were computed by averaging the concept mean scores within the discipline. The highest score (4) denoted the greatest amount of knowledge, or need, and the lowest score of (1) signified the least amount of knowledge or need for the respective concept or discipline. The gap or difference between knowledge level and need were expressed as a positive or negative figure. The higher the negative score the greater was the training requirement for the concept or discipline. Conversely, the higher the positive value the less was the training requirement for the concept or discipline.

The 24 concepts used in the curriculum were categorized in five disciplines. Concepts related to each other were grouped to form disciplines to facilitate fewer groupings so that a more thorough study of each discipline would be possible. The concepts were grouped into the following five disciplines:

- I. Heating, Ventilating, Air Conditioning (HVAC) and Buildings
  - Building Design and Construction
  - Heating
  - Control Systems
  - Ventilation and Air Filtration
  - Refrigeration and Air Conditioning
- II. Economics and Management
  - Payback Analysis
  - Energy Conservation and Quality of the Environment
  - Energy Construction Trends and Environmental Effects
  - Terminology
  - Pricing Structures
  - Energy Management Program
  - Production of Energy
  - Energy Management
- III. Home Economics and Comfort
  - Landscaping
  - Food Processing
  - Lighting
  - Comfort and Environmental Factors
- IV. Agriculture and Transportation
  - Transportation and Power Vehicles
  - Agriculture Production Practices
- V. Thermal Science
  - Energy Recovery
  - Heat Transfer

First Law of Thermodynamics

Second Law of Thermodynamics

Psychrometrics

All phases of the analysis were taken into consideration before formulating a sample curriculum.

### Statistical Analysis

Variables like Extension professionals' characteristics and job-related factors were stated primarily as frequencies and percentages. The relative importance of concepts within and among disciplines was determined by comparing their mean ratings. Mean values were also used to rank disciplines and concepts in order of greatest knowledge, need, and training required (gap).

Inputs to assessing the needs included in the training program included independent variables such as: 1) age, 2) sex, 3) educational background, 4) geographic region, 5) work assignment, 6) tenure in Extension, 7) tenure in Extension energy work, and 8) percent of work-time devoted to energy.

To facilitate testing for statistically significant differences of mean ratings the participants were grouped as follows:

1. Age: 1) younger agents (less than 40 years), and 2) older agents (40 years and over)
2. Sex: 1) male, and 2) female
3. Educational Background Areas: 1) bioscience (animal and plant science), 2) humanities (languages), 3) physical science (engineering), and 4) social science (education including Extension). The Louisiana State University

system of categorizing students was used to group Extension professionals in the four areas of educational background. (See appendix for complete breakdown.)

4. Geographic Regions: 1) Southern Coastal, 2) Intermediate, and 3) Northern. The participants in states with similar needs and requirements for energy training were grouped together. (Agents in the Southern Coastal region could expect to have different problems in heating and air conditioning from those in the Northern region).
5. Work Assignment: 1) State Specialists, and 2) County Workers. State specialists are those agents who indicated a state office assignment. The county workers could either be assigned to work in a single county or in more than one county.
6. Tenure in Extension: 1) Less experienced (less than 10 years), and 2) More experienced (10 years and over)
7. Tenure in Extension Energy Work: 1) Less experienced (under three years), and 2) More experienced (three years and over). Energy work in Extension is relatively new which accounts for the division of energy worktime in small increments.
8. Percent of Worktime Devoted to Energy: 1) Below average (under 50 percent), and 2) Above average (50 percent and over). (For the purpose of this study the author felt that an agent who spends one-half (or 50 percent) or more of his time working in energy would be classified as spending an above average amount of time doing energy work.)

The F test was used to furnish a comprehensive and an overall test of significance of the difference between means of dependent variables. Analysis of variance was applied to test for differences in knowledge level and expressed need for training and gap of selected energy disciplines. The energy disciplines included in the research were 1) heating, ventilating, air conditioning, and buildings, 2) economics and management, 3) home economics and comfort, 4) thermal science, and 5) agriculture and transportation.

Mean scores were computed for each group of variables. On each variable agents were asked to indicate their knowledge level and/or need for including the five major energy disciplines in a training curriculum, using a rating scale of one to four with one representing little or no knowledge and four indicating maximum knowledge. The respondents were categorized in groups for each independent variable. For each independent variable, the mean scores of each group in the five disciplines areas were computed for knowledge level and perceived need for training. A comparison was then made of the different groups' response to the five discipline areas.

The gap rating was calculated by subtracting the need (mean) from the knowledge (mean) value for groups being compared on the five energy disciplines (knowledge - need = gap).

The null hypothesis applied to this study states that for all independent variables there is no statistically significant difference on mean scores of the groups for knowledge level, need for including training, or gap in the five energy disciplines. The null hypothesis will be rejected if the difference is less than .05 - the level of statistical significance selected for all analysis in this research.



Definition of Terms:

The following definitions were used for this study:

1. Energy Conservation - The wise and efficient use of energy.
2. Concept - A fundamental idea or notion which describes a phenomenon or a class of experiences and provides a base of knowledge and generalization.
3. Discipline (conceptual framework) - A set of major concepts developed to delineate a specific field of knowledge in energy.
4. Knowledge - A self-appraisal (subjective) of the extent of knowledge and understanding of concepts and disciplines.
5. Need - An appraisal or measurement of the degree of necessity for including concepts and disciplines in the training.
6. Gap - Training requirement of agents obtained by measuring the differences between the knowledge level and degree of necessity for including concepts or disciplines in the training curriculum.
7. Extension Professionals - Employees of the Cooperative Extension Service in the United States who devote considerable amount of their worktime to energy conservation work. They are also referred to as agents.
8. In-Service Training Curriculum - The curriculum intended to be taught in short courses or training sessions.  
Instruction should be directed toward giving agents a

fundamental background in the principles and technology necessary to comprehend energy conservation.

9. Independent Variables - Those factors which are used to categorize agents in groups so that analysis of knowledge, need, and gap may be evaluated in five selected energy disciplines.
10. Dependent Variables - The knowledge, need, and gap which are directly affected by the respondents' evaluation of them.
11. Below Average - The term used to categorize agents who devote less than 50 percent of their worktime to energy.
12. Above Average - The term used to categorize agents who devote 50 percent or more of their worktime to energy.
13. General Objective - A statement setting forth a long-term solution to a problem which was recognized and identified by the people.
14. Specific Teaching Objective - A statement which expresses more specifically the solution to a problem that can be accomplished within a shorter period of time than that expressed in the general objective.

## Chapter V

### ANALYSIS OF TRAINING NEEDS

The data gathered in the study were analyzed to describe personal and job-related characteristics of Extension professionals and their knowledge, need, and training requirement (gap) in energy subject matter. Relationships between agent characteristics and their knowledge, need, and training requirement were also analyzed in detail and a summary was presented. These analyses were designed to meet the objectives of the study and to test the stated hypotheses.

#### Characteristics of Extension Professionals

Age. The mean age of the 140 Extension professionals doing energy work was 40 years. The youngest respondent was 25; the oldest was 63 years of age. Only two participants were over 60. While 54 percent of the energy workers were under 40, 46 percent were over 40.

Sex. Approximately two-thirds of the respondents were men and slightly less than one-third were women.

Educational Background. The field of study of 140 Extension professionals revealed that one-half of all energy agents received their education in the social sciences (including Extension education) followed by 32 percent in the physical sciences (including engineering), 11 percent in the bio-sciences (including animal and plant sciences), and seven percent in the humanities (including languages). Over two-thirds of the agents received their educational

training in the social or physical sciences. (See appendix for a list on Division of Education Background).

Work Location and Assignment. Nearly one-half of the respondents were from the Southern Coastal States while the Intermediate and Northern regions each had approximately one-fourth of the participants (Table I). The state of Florida had 23 respondents (17 percent), the largest group, while New Mexico and Wyoming had the smallest number of participants, each with two people (one percent).

Table I also showed that approximately two-thirds of the energy employees surveyed were state specialists and about one-third worked at a county level. Significantly, the state of Tennessee was the only state in the Intermediate region with participants at the county level (one percent). The Northern region was the only group that had more participants working in the field (14 percent) than respondents who were stationed at the state office (11 percent). The Southern Coastal and Northern region each had a fairly even distribution of respondents who worked at the state office and county level.

Tenure in Extension. As shown in Table II, over one-half of the agents had Extension employment tenure of less than 10 years. Only 46 percent of the respondents had 10 or more years of employment in the CES. The range in years of experience was from one to 31 years. Two people had over 30 years of experience while nearly one-third of the participants had three years or less experience. Mean tenure was 10 years.

TABLE I

DISTRIBUTION OF WORK LOCATION OF  
EXTENSION PROFESSIONALS IN ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

STATE	Percent by Work Location		Total (N = 140)
	State Staff (N = 89)	County Staff (N = 51)	
<u>Southern Coastal</u>			
Georgia	3	3	6
Florida	9	8	17
Texas	2	1	3
Mississippi	5	2	7
Alabama	4	0	4
Louisiana	4	6	10
Total	27	20	47
<u>Intermediate</u>			
New Mexico	1	0	1
Tennessee	2	1	3
Virginia	5	0	5
Kentucky	4	0	4
South Carolina	3	0	3
Arkansas	4	0	4
North Carolina	4	0	4
Oklahoma	4	0	4
Total	27	1	28
<u>Northern</u>			
Pennsylvania	3	6	9
Wisconsin	4	1	5
Michigan	2	2	4
Connecticut	1	3	4
Washington	0	2	2
Wyoming	1	0	1
Total	11	14	25
Overall Total	65	35	100

Tenure of Extension Energy Work. The newness of energy conservation work in CES accounts for the few years respondents indicated having been engaged in this area. Nearly one-half stated that they had done Extension energy work for two years or less (Table II). The majority had three or more years experience in Extension energy

education. The experience ranged from one to four years and mean tenure was three years.

TABLE II

DISTRIBUTION OF TENURE OF EXTENSION PROFESSIONALS  
IN EXTENSION WORK AND IN EXTENSION ENERGY WORK,  
SOUTHERN REGION AND PILOT STATES OF THE UNITED STATES, 1981

<u>Tenure</u> <u>Extension Experience</u> (years)	<u>Percent</u> (N = 131)
Less Experienced (less than 10)	54
More Experienced (10 or more)	46
Total	100
Mean: 10	
Range: 1-31	
<hr/>	
<u>Extension Energy Experience</u> (years)	<u>Percent</u> (N = 112)
Less Experienced (less than 3)	42
More Experienced (3 or more)	58
Total	100
Mean: 3	
Range: 1-4	

Amount of Worktime Devoted to Energy. Extension professionals were categorized in below average and above average groups in terms of percentage of worktime devoted to energy education (Table III). Over one-half of the respondents spent 50 percent or more of their time doing energy work. Actually one-third of all participants indicated that they spent 100 percent of their worktime in energy. Some 41 percent of the energy employees spent less than 50 percent of their worktime in energy education. Only 14 percent of the people in the study devoted less than 10 percent of their worktime to energy. The average percentage of

worktime devoted to energy was 59 percent and the range varied from one to 100 percent.

TABLE III  
DISTRIBUTION OF WORKTIME DEVOTED TO  
ENERGY BY EXTENSION PROFESSIONALS,  
SOUTHERN REGION AND PILOT STATES OF THE UNITED STATES, 1981

<u>Energy Worktime</u> <u>Grouped by Percent</u>	<u>Percent</u> <u>(N = 138)</u>
Below average (under 50%)	41
Above Average (50% or over)	59
Total	100.00
Mean: 59	
Range: 1-100	

#### Knowledge, Need and Gap of Energy Subject Matter

Differences in Knowledge and Need to Determine Training Priority (Gap) in Selected Disciplines of Extension Professionals. The concepts included in the study were grouped in categories and called disciplines. Concepts that were similar were grouped together so that an initial investigation could be conducted on these disciplines to be followed by an analysis of individual concepts.

The gap or training requirement in disciplines/concepts was determined by subtracting the expressed need (mean) scores from the knowledge (mean) scores in each case. If the gap had a negative value this meant there was a training requirement; the greater the negative value the larger was the training requirement.

An overall analysis of disciplines (Table IV) revealed that respondents had the largest gap (-.64 mean) in HVAC and buildings with agriculture and transportation (-.63 mean) being a close second.

Thermal science was the discipline with the smallest gap (-.30 mean) followed closely by home economics and comfort (-.31 mean). Economics and management fell in the middle with a mean gap of -.46.

TABLE IV

COMPARISON OF MEANS AND RANKING ON KNOWLEDGE, NEED, AND GAP IN SELECTED DISCIPLINES FOR EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

Disciplines	OVERALL Mean Scores and Ranking					
	Knowledge <sup>a/</sup>		Need <sup>a/</sup>		Gap <sup>b/</sup>	
	(n = 140)		(n = 140)		(n = 140)	
	Mean	Rank	Mean	Rank	Mean	Rank
HVAC & Buildings	2.58	1	3.22	1	-.64	1
Agriculture & Transportation	2.42	5	3.05	2	-.63	2
Economics and Management	2.55	2	3.01	3	-.46	3
Home Economics & Comfort	2.48	3	2.79	4	-.31	4
Thermal Science	2.44	4	2.74	5	-.30	5

a/ The disciplines were rated on a 4 point scale for knowledge and expressed need. The higher the score the greater the knowledge and expressed need.

b/ The difference between knowledge level and expressed need. The larger the negative value the greater the training requirement (gap).

The need or necessity for including the five disciplines in the training curriculum was viewed by agents in the same rank order as gap ranking.

When the knowledge level of participants was compared with the ranking of gap and need one major variation in agriculture and transportation was found. This discipline ranked last in knowledge as opposed to the second position it held in need and gap. The knowledge ranking, with that one exception, followed the same order as that recorded for gap and need.



Mean Differences and Ranking of Concepts. The concept agriculture production practices ranked first in gap (-.91 mean) (Table V) which indicated that participants' need for including training in this concept surpassed their knowledge to a greater degree than any of the other concepts. Interestingly, none of the concepts in the HVAC and buildings discipline had a gap rating lower than ninth place. The concept building design and construction had a third place in gap, and was ranked first in need and knowledge.

Within the discipline of economics and management, the concept of payback analysis rated an overall second on both gap and need, and the concept of terminology and energy management programs ranked second and third, respectively, in knowledge.

The discipline of thermal science had the concepts with the lowest rankings. Conspicuously ranked last among individual concepts were psychrometrics in gap and need and energy recovery in knowledge. The concept on the first law of thermodynamics was rated twenty third among gap placings.

Differences in Knowledge and Need for Including Selected Disciplines by Age of Extension Professionals. Respondents were grouped in two age brackets, 1) younger agents (less than 40 years), and 2) older agents (40 years & over). The null hypothesis was that there is no statistically significant difference between mean scores for knowledge and need of younger agents when compared with older agents in five disciplines of energy.

The data in Table VI denoted that there were no statistically

TABLE V

OVERALL MEANS AND RANKINGS ON KNOWLEDGE, NEED, AND GAP  
FOR SELECTED ENERGY CONCEPTS AMONG EXTENSION PROFESSIONALS,  
SOUTHERN REGION AND PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE & CONCEPT	Mean and Overall Ranking					
	Knowledge <sup>a/</sup>		Need <sup>a/</sup>		Gap <sup>b/</sup>	
	Mean	Rank	Mean	Rank	Mean	Rank
<u>HVAC and buildings</u>						
Building design & construction	2.99	1	3.67	1	-.68	3
Heating	2.66	6	3.33	3	-.67	4
Control systems	2.58	15*	3.09	8	-.66	5
Ventilation & air filtration	2.61	9*	3.24	5	-.63	7
Refrigeration & air conditioning	2.21	22	2.75	17*	-.54	9
<u>Agriculture and transportation</u>						
Agriculture production practices	2.25	21	3.16	7	-.91	1
Transportation & power vehicles	2.61	9*	2.95	11	-.34	18
<u>Economics and management</u>						
Payback analysis	2.69	5	3.47	2	-.78	2
Energy conservation & quality of environment	2.19	23	2.75	17*	-.56	8
Energy costs, trends & environmental effects	2.29	19*	2.81	13*	-.51	10
Terminology	2.84	2	3.29	4	-.46	11
Pricing structures	2.64	7*	3.04	10	-.41	13*
Energy management programs	2.81	3	3.21	6	-.40	15
Production of energy	2.36	17	2.71	21*	-.35	16*
Energy measurements	2.52	12	2.74	19*	-.21	22
<u>Home economics and comfort</u>						
Landscaping	2.49	13*	2.91	12	-.41	13*
Food processing	2.34	18	2.69	23	-.35	16*
Lighting	2.59	13*	2.74	19*	-.25	20
Comfort & environmental factors	2.59	11	2.81	13*	-.22	21
<u>Thermal science</u>						
Energy recovery	2.14	24	2.78	15	-.64	6
Heat transfer	2.64	7*	3.08	9	-.44	12
Second law - thermodynamics	2.43	15*	2.71	21*	-.28	19
First law - thermodynamics	2.70	4	2.77	16	-.07	23
Psychrometrics	2.31	19*	2.38	24	-.06	24

a/ Based on a 4 point scale on knowledge and need of 140 Extension professionals: 1=little or no knowledge or need, and 4=maximum knowledge or need.

b/ Based on the difference between knowledge and need; the larger the negative score the greater the expressed training requirement or gap.

\*Denotes ties in rankings.

significant differences in knowledge level of younger agents when compared with the older group in the five energy disciplines.

TABLE VI

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES IN THE CURRICULUM WITH AGE OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

Discipline	Mean Knowledge <sup>a/</sup> by Age		F <sup>b/</sup>	P
	Younger agents (Under 40 years)	Older agents (40 years & over)		
HVAC & buildings	2.57	2.59	.04	<.83
Economics & management	2.58	2.52	.26	<.60
Home economics & comfort	2.49	2.44	.30	<.58
Thermal science	2.46	2.44	.04	<.84
Agriculture & transportation	2.44	2.45	.00	<.95

Discipline	Mean Need <sup>a/</sup> by Age		F <sup>b/</sup>	P
	Younger agents (Under 40 years)	Older agents (40 years & over)		
HVAC & buildings	3.21	3.23	.06	<.81
Economics & management	3.00	3.01	.02	<.87
Home economics & comfort	2.66	2.92	5.58	<.01
Thermal science	2.63	2.86	5.64	<.01
Agriculture & transportation	3.02	3.10	.58	<.44

a/ The disciplines were rated on a four point scale for knowledge and need with 4 indicating maximum value.

b/ With 1 and 134 df.

When the two age groups were tested for need for including disciplines in a training program, older agents clearly expressed a greater need for training in home economics and comfort (2.92 mean) and thermal science (2.86 mean) when compared with the younger group, each having lower mean values, 2.66 and 2.63, respectively. The figures represent a statistically significant difference, so the null hypothesis

of no difference was rejected. Simply stated, the research disclosed that age group influenced agents' expressed need for including the two disciplines in the training curriculum.

Gap (Training Requirement) by Age of Extension Professionals.

The null hypothesis was that there is no statistically significant difference between gap scores of younger agents when compared with the older group in five disciplines in energy.

A comparison of the gap of younger agents with older ones revealed that only one discipline, home economics and comfort, was statistically significantly different ( $P < .009$ ) because the older group had a larger training requirement (-.49 mean) when compared with the younger people (-.18 mean) (Table VII). In that case the older group expressed a greater training demand gap in that discipline. The final assessment is that the other four disciplines are very similar, and age of agents had no bearing on type of training wanted.

TABLE VII

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH AGE OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

Disciplines	Mean Gap <sup>a/</sup> by Age		F <sup>b/</sup>	P
	Younger agents (Under 40 years)	Older Agents (40 years & over)		
HVAC & buildings	-.64	-.63	.00	<.97
Economics & management	-.43	-.49	.29	<.58
Home economics & comfort	-.18	-.49	6.98	<.009
Thermal science	-.17	-.43	3.52	<.06
Agriculture & transportation	-.58	-.65	.22	<.64

a/ The gap is the difference between knowledge and need. The larger the negative value the greater the training requirement or gap.

b/ With 1 and 134 df.

Differences in Knowledge and Need for Including Selected Disciplines in the Curriculum by Sex of Extension Professionals.

Participants were compared by sex for the purpose of testing the differences between males and females. The null hypothesis being considered was that there is no statistically significant difference on mean scores for knowledge and/or need of males when tested against females in five selected disciplines of energy.

The research indicated that the knowledge level of men when compared with women was statistically significantly different for all disciplines studied (Table VIII). A revealing fact was that men expressed much greater knowledge level than women in four of the five disciplines. However, in the discipline of home economics & comfort women disclosed a much higher level of knowledge (2.82 mean) when compared with men (2.32 mean). The findings suggest that the educational background and training that men received was more conducive and prepared them to respond to a higher knowledge level than women on HVAC & buildings, economics & management, thermal science, and agriculture & transportation. The reverse was found in home economics & comfort where women were more knowledgeable than men.

A similar finding was made for need on home economics & comfort where females again expressed a statistically significantly higher requirement (3.15 mean) than males (2.62 mean). Even though women had a higher knowledge level than men, they still expressed greater need for including training in home economics & comfort than men. These findings support the thinking that people want to learn more about the disciplines in which they are more knowledgeable.

TABLE VIII  
A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES IN THE  
CURRICULUM WITH SEX OF EXTENSION PROFESSIONALS DOING ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

Discipline	Mean Knowledge <sup>a/</sup> by Sex			P
	Male	Female	F <sup>b/</sup>	
HVAC & buildings	2.73	2.25	17.12	<.0001
Economics & management	2.63	2.40	4.61	<.03
Home economics & comfort	2.32	2.82	27.05	<.0001
Thermal science	2.64	2.00	27.31	<.0001
Agriculture & transportation	2.72	1.80	58.60	<.0001

Discipline	Mean Need <sup>a/</sup> by Sex			P
	Male	Female	F <sup>b/</sup>	
HVAC & buildings	3.19	3.28	0.94	<.33
Economics & management	2.99	3.28	0.63	<.42
Home economics & comfort	2.62	3.15	24.88	<.0001
Thermal science	2.76	2.70	0.27	<.60
Agriculture & transportation	3.07	3.01	0.27	<.60

a/ The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

b/ With 1 and 140 df.

#### Gap (Training Requirement) by Sex of Extension Professionals.

The null hypothesis was that there is no statistically significant difference between mean gap scores of males when compared with the values for females in the five selected disciplines.

The finding was that males and females had practically the same gap difference (-.30 & -.33) in home economics & comfort (Table IX). Although the knowledge and need for both sexes had been highly significant in that discipline, the finding implied that women were more knowledgeable and expressed a greater need for including the discipline of home economics & comfort in the training program while men have a correspondingly lower knowledge and need, yet the gap

difference for that discipline was not significantly different. Another assessment is that men need to receive a small amount of training to the same degree that women need to receive a large amount of training in the discipline being studied, but that difference is not statistically significant.

TABLE IX

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH SEX OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

Discipline	Mean Gap <sup>a/</sup> by Sex		F <sup>b/</sup>	P
	Male	Female		
HVAC & buildings	-.46	-1.03	18.20	<.0001
Economics & management	-.36	-.66	5.90	<.01
Home economics & comfort	-.30	-.33	.06	<.81
Thermal science	-.11	-.70	18.82	<.0001
Agriculture & transportation	-.35	-1.22	31.50	<.0001

a/ The mean gap is the difference between knowledge and need. The larger the negative score the greater the training requirement gap.

b/ With 1 and 140 df.

The gaps for men and women in HVAC & buildings, economics & management, thermal science, and agriculture & transportation were rejected at the .05 level of probability as being statistically significantly different. This implies that training requirements for men and women in these four disciplines do indeed differ, and training curriculum should reflect these findings. In all cases, women had a greater training requirement (gap) than men.

Differences in Knowledge and Need for Including Selected Disciplines in the Curriculum by Educational Background of Extension Professionals. For analytic purposes, agents were categorized into four areas of educational background: 1) bioscience (animal & plant science), 2) humanities (languages), 3) physical science (engineering), 4) social science (education including Extension). The null hypothesis is that there is no statistically significant difference between mean scores of knowledge and/or need for groups of agents with different educational background in five selected disciplines in energy.

The knowledge level data in Table X imply that agents with different educational backgrounds had statistically significant differences on their expressed knowledge for all disciplines tested. Expressively shown in the statistics is that knowledge level mean scores for agents with degrees in the field of humanities (languages) were the lowest when compared with the other groups of educators in all five disciplines. On the other hand, the physical sciences majors (engineering) had the largest expressed knowledge mean of all agent groups tested in four of the energy disciplines. In that one exception, agents with social science degrees (Extension educators) had the highest expressed knowledge score (2.66 mean) compared with a 2.29 mean for the physical sciences group.

In the rating for need of disciplines to be included in the training of agents with different educational background there was found to be no statistically significant difference in four of the five disciplines. Because of the high need expressed by the social sciences



(Extension educators) group (3.02 mean) when compared to the low need of the physical science (engineers) group (2.47 mean) for the discipline of home economics & comfort, the difference was found to be statistically significant. Further conclusions were that all groups of agents expressed the same need for including training in the areas of HVAC & buildings, economics & management, thermal science, and agriculture & transportation.

TABLE X

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES  
IN THE CURRICULUM WITH EDUCATIONAL BACKGROUND OF  
EXTENSION PROFESSIONALS DOING ENERGY WORK.  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> By Educational Background				F <sup>b/</sup>	P
	Bio- Sciences	Human- ities	Physical Sciences	Social Sciences		
HVAC & buildings	2.51	2.16	3.06	2.32	16.36	<.0001
Economics & management	2.46	2.25	2.79	2.45	4.72	<.003
Home economics & comfort	2.53	2.00	2.29	2.66	6.82	<.0003
Thermal science	2.48	1.82	3.04	2.10	27.61	<.0001
Agriculture & transportation	2.25	2.06	2.93	2.18	11.69	<.0001

DISCIPLINE	MEAN NEED <sup>a/</sup> By Educational Background				F <sup>b/</sup>	P
	Bio- Sciences	Human- ities	Physical Sciences	Social Sciences		
HVAC & buildings	3.35	3.31	3.18	3.20	.59	<.62
Economics & management	3.25	2.94	2.91	3.03	1.75	<.15
Home economics & comfort	2.88	2.53	2.47	3.02	8.63	<.0001
Thermal science	2.91	2.44	2.81	2.70	1.54	<.20
Agriculture & transportation	3.16	2.89	2.94	3.13	1.17	<.32

a/ The disciplines were rated on a four point scale for knowledge and need with 4 indicating maximum value.

b/ With 3 and 139 df.

Gap (Training Requirement) in Selected Disciplines by Educational Background of Extension Professionals. The null hypothesis is that there is no statistically significant difference between educational background and gap (training requirement).

An observation of the gap (means) between agents of various educational backgrounds denotes that statistically significant differences (Table XI) were found in four of the five areas of energy being studied. The research revealed that agents with degrees in divergent major fields of study have statistically significant differences in training requirements in the areas of HVAC & buildings, economics & management, thermal science, and agriculture & transportation. These findings reveal that the agents in the physical sciences (engineering) group when compared with agents with other backgrounds have the smallest mean value indicating that their need for training does not exceed their knowledge level (gap mean) by as large a margin as that of agents in other groups. In fact, the physical science group had the only positive gap in the study for the discipline of thermal sciences (+.23) where knowledge surpassed the need for training. Conversely, the largest gap was found in the discipline of HVAC & buildings (-1.16) for agents in the humanities field, which suggests that need for training exceeded knowledge level in that area by the greatest margin.

The discipline of home economics & comfort had the only gap that was not statistically significant for the groups being studied, when in fact it was the only discipline that was found to be statistically significantly different for both need and knowledge.

The conclusion supports the fact shown by the physical sciences people where they related their knowledge of home economics & comfort low (2.29 mean) but also felt the lowest need (2.47 mean) for the discipline to be included in the training, resulting in the only small gap difference that is not statistically significant.

TABLE XI

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED DISCIPLINES WITH EDUCATIONAL BACKGROUND OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> by Educational Background				F <sup>b/</sup>	P
	Bio-sciences	Humanities	Physical sciences	Social sciences		
HVAC & buildings	-.84	-1.16	-.13	-.87	13.40	<.0001
Economics & management	-.79	-.69	-.12	-.58	6.82	<.0003
Home economics & comfort	-.34	-.53	-.19	-.36	.90	<.44
Thermal science	-.44	-.62	+.23	-.59	14.31	<.0001
Agriculture & transportation	-.91	-.83	-.01	-.96	12.98	<.0001

a/ The mean gap is the difference between knowledge and need. The larger the negative value the greater training requirement.

b/ With 3 and 139 df.

Differences in Knowledge and Need for Including Selected Disciplines in the Curriculum by Geographic Regions of Extension Professionals. Agents were grouped by states with similar needs and requirements for energy training. Groupings were as follows:

1) Southern Coastal, 2) Intermediate, and 3) Northern. The null hypothesis states that there is no statistically significant difference in the knowledge and training need of agents working in different regions of the United States.

In comparing the expressed knowledge of agents from different geographic regions with various energy disciplines, there was found to be no statistically significant difference in three of the disciplines; however, in home economics & comfort, and in thermal science, the knowledge differences expressed were statistically significant (Table XII). The largest knowledge difference was in the area of home economics & comfort where a high score (2.61 mean) was recorded for agents in the Southern Coastal region, and the lowest value (2.32 mean) was expressed in the same area by the Northern region. Interestingly, the Southern Coastal region had the lowest (2.28 mean) knowledge value for thermal science while the agents from the Intermediate region gave the highest (2.66 mean) rating for that discipline. So the research indicates that agents from different regions of the United States expressed significantly different knowledge levels in only two disciplines, home economics & comfort and thermal science, and no statistically significant difference for the disciplines in HVAC & buildings, economics & management, and agriculture & transportation.

When evaluating the need of agents, the findings revealed two disciplines, home economics & comfort ( $p < .0001$ ) and HVAC & buildings ( $p < .01$ ) to be statistically significantly different. The largest need difference was found in the home economics & comfort discipline where agents from the Southern Coastal region expressed a high need (3.03 mean) value as opposed to the low (2.54 mean) rating for the Northern region. Very similar need differences were noted in HVAC & buildings in which the Southern Coastal group stated a high need

(3.33 mean) when compared with the low (3.03 mean) for the Northern regions. The findings indicate that the null hypothesis of no statistically significant difference was rejected because of the large difference in expressed need for including the disciplines of home economics & comfort and HVAC & buildings in an energy training program by agents from different geographic areas. However, in the disciplines of economics & management, thermal science, and agriculture & transportation, the agents agreed that these areas were very similar as to the need for including these disciplines in a training curriculum.

TABLE XII

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES IN THE CURRICULUM WITH GEOGRAPHIC REGION OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> by Region			F <sup>b/</sup>	P
	Southern Coastal	Inter-mediate	Northern		
HVAC & buildings	2.48	2.75	2.56	1.97	<.14
Economics & management	2.52	2.62	2.52	.41	<.66
Home economics & comfort	2.61	2.38	2.32	3.85	<.02
Thermal science	2.28	2.66	2.47	3.41	<.03
Agriculture & transportation	2.38	2.56	2.35	.82	<.44

DISCIPLINE	MEAN NEED <sup>a/</sup> by Region			F <sup>b/</sup>	P
	Southern Coastal	Inter-mediate	Northern		
HVAC & buildings	3.33	3.18	3.03	4.34	<.01
Economics & management	3.09	2.86	3.02	2.40	<.09
Home economics & comfort	3.03	2.59	2.54	10.85	<.0001
Thermal science	2.77	2.72	2.70	.19	<.82
Agriculture & transportation	3.08	2.97	3.08	.40	<.66

a/ The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

b/ With 2 and 140 df.

Gap (Training Requirement) for Energy Training by Geographic Regions of Extension Professionals. The null hypothesis is that there is no statistically significant difference between mean gap scores of agents from different regions in the five selected disciplines.

When comparing the gap values computed for different geographic regions, there was found to be a statistically significant difference in HVAC & buildings, thermal science, and economics & management (Table XIII). The biggest difference was found in HVAC & buildings between agents in the Southern coastal region (-.85 mean) while the Intermediate group had a gap (-.43 mean) and the Northern region showed a 0.46 mean rating. Likewise, in thermal science and economics & management, the largest gap difference was between agents in the Southern region when compared with the mean for agents in the Intermediate region. The conclusion is that there were statistically significant differences between agents from different geographic areas in the type of energy training desired in HVAC & buildings, thermal science, and economics & management while training desired was equal in the disciplines of home economics & comfort and agriculture & transportation. The findings suggest that training requirements in the disciplines of HVAC & buildings, thermal science, and economics & management are different and are peculiar to each geographic area.

Differences in Knowledge and Need for Including Selected Disciplines in the Curriculum by Work Assignment of Extension Professionals. Agents were categorized in two divisions - 1) state staff, and 2) county staff. The null hypothesis is that there is no statistically significant difference between state staff and county

staff workers on knowledge level and/or need for including selected disciplines in a training curriculum.

TABLE XIII

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH GEOGRAPHIC REGION OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> Region			F <sup>b/</sup>	P
	Southern Coastal	Inter-mediate	Northern		
HVAC & buildings	-.85	-.43	-.46	4.98	<.008
Economics & management	-.56	-.24	-.49	2.96	<.05
Home economics & comfort	-.41	-.20	-.22	1.54	<.21
Thermal science	-.48	-.06	-.23	4.01	<.02
Agriculture & transportation	-.70	-.41	-.72	1.48	<.23

a/ The mean gap is the difference between knowledge and need. The larger the negative value the greater the need for training.

b/ With 2 and 140 df.

When the expressed knowledge level was investigated, scores (means) for state staff were higher in four disciplines when compared with the same test applied to county staff workers (Table XIV). However, in only three disciplines were the differences sufficiently high to justify rejecting the null hypotheses in HVAC & buildings, thermal science, and agriculture & transportation. Only in the area of home economics & comfort did the knowledge score of county staff (2.61 mean) exceed that of state staff (2.40 mean), a statistically significant variation.

When comparing the need difference of state and county staff workers there was only one discipline, home economics & comfort, that was statistically significantly different. Accounting for the large

divergent score was the fact that county staffs expressed a much greater need (3.00 mean) than state personnel who had a lower score (2.66 mean). The data favor a slightly higher need score for state personnel than county staff workers on the other four disciplines, but not to a point of comparable importance. The findings reveal that only one discipline, home economics & comfort, had a statistically significant variation between the two groups.

TABLE XIV

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING  
DISCIPLINES IN THE CURRICULUM TO WORK ASSIGNMENT  
OF EXTENSION PROFESSIONALS DOING ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> by Work Assignment			
	State Staff	County Staff	F <sup>b/</sup>	P
HVAC & buildings	2.66	2.42	4.42	<.03
Economics & management	2.62	2.44	3.22	<.07
Home economics & comfort	2.40	2.61	4.41	<.03
Thermal science	2.59	2.18	10.68	<.001
Agriculture & transportation	2.56	2.19	7.97	<.005

DISCIPLINE	MEAN NEED <sup>a/</sup> by Work Assignment			
	State Staff	County Staff	F <sup>b/</sup>	P
HVAC & buildings	3.15	3.31	3.29	<.07
Economics & management	2.97	3.06	.99	<.32
Home economics & comfort	2.66	3.00	10.47	<.0001
Thermal science	2.68	2.84	2.50	<.11
Agriculture & transportation	3.02	3.09	.37	<.54

a/ The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

b/ With 1 and 140 df.

Gap (Training Requirement) by Work Assignment of Extension Professionals. The null hypothesis states that agents in various work assignments have no statistically significant differences between mean gap scores as to their training need.



When comparing the gap of state and county staff workers there was found to be a statistically significant difference in four of the five disciplines (Table XV). The only nonsignificance was found in the home economics & comfort discipline ( $P < .25$ ). However, in the other four disciplines, HVAC & buildings, economics & management, thermal science, and agriculture & transportation, there were statistically significant differences. This suggests that curriculum modification would be helpful in four disciplines when considering energy training requirements of state office employees and county field personnel.

TABLE XV

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH WORK ASSIGNMENT OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> By Work Assignment			P
	State Staff	County Staff	F <sup>b/</sup>	
HVAC & buildings	-.48	-.89	9.35	<.002
Economics & management	-.35	-.62	5.24	<.02
Home economics & comfort	-.25	-.39	1.29	<.25
Thermal science	-.09	-.66	19.42	<.0001
Agriculture & transportation	-.46	-.91	7.99	<.005

a/ The mean gap is the difference between knowledge and need. The larger the negative value the greater the training requirement.

b/ With 1 and 140 df.

Difference in Knowledge and Need for Including Selected Disciplines in the Curriculum by Tenure in Extension of Extension Professionals. For the purpose of analysis, participants were grouped in two clusters according to tenure in Extension work - 1) less

experienced agents (less than 10 years), and 2) more experienced agents (10 years & over). The null hypothesis tested was that there were no statistically significant differences between mean scores for knowledge and need of less experienced agents when compared with more experienced agents in five disciplines of energy.

The findings in Table XVI reveal that knowledge mean score differences did not exist between the two groups with the exception of the economics & management category, in which case the probability level ( $P < .03$ ) indicated a statistically significant difference between the two groups. The less experienced agents expressed a higher degree of knowledge (2.63 mean) than their more experienced counterparts who had a lower score (2.42 mean).

The need means indicate that the experience of agents made no statistically significant difference on expressed need for type of training to be included in the curriculum. In other words, the less experienced agents exhibited the same degree of need in all disciplines as the more experienced agents.

The conclusion may be drawn that agents with less experience when compared with more experienced agents had the same need and knowledge level on all disciplines except economics & management, where agents with less experience signified a higher level of knowledge (2.63 mean) when compared with their counterparts (2.42 mean).

Gap (Training Requirement) by Tenure in Extension of Extension Professionals. The null hypothesis is that there is no statistically significant difference between mean gap scores of less experienced agents when compared with the more experienced group in the five selected disciplines.

TABLE XVI

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES  
IN THE CURRICULUM WITH TENURE IN EXTENSION OF  
EXTENSION PROFESSIONALS DOING ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> by Tenure in Extension		F <sup>b/</sup>	p
	Less Experienced (under 10 yrs.)	More Experienced (10 yrs. & over)		
HVAC & buildings	2.57	2.57	.00	<.97
Economics & management	2.63	2.42	4.66	<.03
Home economics & comfort	2.46	2.44	.01	<.90
Thermal science	2.45	2.40	.15	<.69
Agriculture & transportation	2.44	2.45	.00	<.96

DISCIPLINE	MEAN NEED <sup>a/</sup> by Tenure in Extension		F <sup>b/</sup>	p
	Less Experienced (under 10 yrs.)	More Experienced (10 yrs. & over)		
HVAC & buildings	3.24	3.20	.14	<.70
Economics & management	3.03	2.94	1.14	<.28
Home economics & comfort	2.75	2.79	.11	<.74
Thermal science	2.73	2.76	.09	<.76
Agriculture & transportation	3.04	3.07	.05	<.82

a/ The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

b/ With 1 and 131 df.

When comparing the gap for less experienced and more experienced agents there were no statistically significant differences in training wants for any of the five energy disciplines (Table XVII). The conclusion can be drawn that tenure in Extension work had no influence on the ultimate training requirement of Extension professionals in the five major disciplines of energy.

Differences in Knowledge and Need for Including Selected Disciplines in the Curriculum by Tenure in Extension Energy Work of

Extension Professionals. Agents were grouped by tenure in Extension energy work experience as follows: 1) less experienced agents (under 3 years), and 2) more experienced (3 years & over). The null hypothesis being tested was that there is no statistically significant difference between less and more experienced groups in their knowledge and training need in five energy disciplines.

TABLE XVII

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN  
SELECTED ENERGY DISCIPLINES WITH TENURE IN EXTENSION  
OF EXTENSION PROFESSIONALS DOING ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> by Tenure in Extension		F <sup>b/</sup>	P
	Less Experienced (under 10 yrs.)	More Experienced (10 yrs. & over)		
HVAC & buildings	-.67	-.63	.07	<.78
Economics & management	-.41	-.53	.89	<.34
Home economics & comfort	-.29	-.34	.16	<.68
Thermal science	-.27	-.35	.32	<.57
Agriculture & transportation	-.59	-.62	.01	<.91

a/ The mean gap represents the difference between knowledge and need.  
The larger the negative score the greater the training requirement.

b/ With 1 and 131 df.

When comparing the knowledge level of less experienced and more experienced agents, the data imply that there were no statistically significant differences in the expressed knowledge level between the groups in any of the five disciplines of energy in the test (Table XVIII). Interestingly, when the need levels of the less experienced agents were compared to those of the more experienced agents for the disciplines of agriculture & transportation and economics & management,

the need level of less experienced agents was greater in both disciplines than that of their more experienced counterparts in the same disciplines. Even in the three other disciplines, HVAC & buildings, economics & management, and thermal science the agents with less experience expressed a greater need than the other group, but this difference was not statistically significant.

TABLE XVIII

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING DISCIPLINES IN THE CURRICULUM WITH TENURE IN EXTENSION ENERGY WORK OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> by Extension Energy Work Tenure		F <sup>b/</sup>	P
	Less Experienced (under 3 yrs.)	More Experienced (3 yrs. & over)		
HVAC & buildings	2.44	2.65	2.55	<.11
Economics & management	2.56	2.58	.02	<.88
Home economics & comfort	2.57	2.41	1.97	<.16
Thermal science	2.38	2.52	1.01	<.31
Agriculture & transportation	2.43	2.41	.01	<.90

DISCIPLINE	MEAN NEED <sup>a/</sup> by Extension Energy Work Tenure		F <sup>b/</sup>	P
	Less Experienced (under 3 yrs.)	More Experienced (3 yrs. & over)		
HVAC & buildings	3.29	3.17	1.82	<.18
Economics & management	3.13	2.98	2.18	<.14
Home economics & comfort	2.94	2.70	4.63	<.03
Thermal science	2.82	2.72	.77	<.38
Agriculture & transportation	3.22	2.94	6.38	<.01

<sup>a/</sup> The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

<sup>b/</sup> With 1 and 112 df.

Gap (Training Requirement) by Tenure in Extension Energy Work of Extension Professionals. The null hypothesis is that there is no

statistically significant difference between mean gap scores of agents with less experience in energy work and those of the other group with more experience.

The findings in Table XIX indicate that the training requirement (gap) of less experienced agents is generally higher than that of the more experienced group. However, only in HVAC & buildings were these variations large enough to be statistically significant ( $p < .02$ ). The training desired by the groups of agents on the other four disciplines did not vary enough to be meaningful when energy work experience was the criterion for judgment.

TABLE XIX

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH TENURE IN EXTENSION ENERGY WORK OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> by Extension Energy Work		F <sup>b/</sup>	P
	Less Experienced (under 3 yrs.)	More Experienced (3 yrs. & over)		
HVAC & buildings	-.85	-.52	5.08	.02
Economics & management	-.56	-.40	1.73	.19
Home economics & comfort	-.37	-.29	.38	.53
Thermal science	-.44	-.21	3.09	.08
Agriculture & transportation	-.80	-.53	2.45	.12

a/ The mean gap represent the differences between knowledge and need. The larger the negative score the greater the training requirement.

b/ With 1 and 112 df.

Difference in Knowledge and Need for Including Selected Disciplines in the Curriculum by Amount of Worktime Devoted to Energy of Extension Professionals. Agents were categorized as 1) below average

group (less than 50 percent) and 2) above average group (50 percent or more) in terms of percent of worktime each one devotes to energy work. The null hypothesis tested was that there is no statistically significant difference between agents who spend a below average amount (less than 50 percent) of worktime in energy when compared with the group who devoted an above average amount (50 percent or more) of their worktime in energy.

When the knowledge level of agents with below average amounts of worktime devoted to energy work was compared with the above-average group, there was a statistically significant difference in the discipline of economics & management as evidenced by the high score of the above average group (2.71 mean) as opposed to the low rating expressed by the below average group (2.35 mean) (Table XX). Knowledge for the other four disciplines by percent of worktime devoted to energy did not vary significantly.

In comparing the need of agents with percent of worktime each group devoted to energy the findings imply and support the null hypothesis that there is no statistically significant difference in the expressed need for including training in any of the energy disciplines in this area.

Gap (Training Requirement) by Amount of Worktime in Energy of Extension Professionals. The null hypothesis stated that there is no statistically significant difference between groups of agents who devote more or less of their worktime to energy.

When evaluating differences between the two groups , those with below average and those with above average worktime in energy, there was

no statistically significant difference in training requirements in all disciplines (Table XXI).

TABLE XX

A COMPARISON OF KNOWLEDGE AND NEED FOR INCLUDING  
DISCIPLINES IN THE CURRICULUM WITH AMOUNT OF WORKTIME DEVOTED TO  
ENERGY OF EXTENSION PROFESSIONALS DOING ENERGY WORK,  
SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN KNOWLEDGE <sup>a/</sup> by Worktime in Energy		F <sup>b/</sup>	P
	Below average (under 50%)	Above average (50% & over)		
HVAC & buildings	2.51	2.65	1.60	<.20
Economics & management	2.35	2.71	13.61	<.0003
Home economics & comfort	2.39	2.53	1.98	<.16
Thermal science	2.36	2.54	1.99	<.16
Agriculture & transportation	2.55	2.38	1.74	<.18

DISCIPLINE	MEAN NEED <sup>a/</sup> by Worktime in Energy		F <sup>b/</sup>	P
	Below average (under 50%)	Above average (50% & over)		
HVAC & buildings	3.17	3.28	1.55	<.21
Economics & management	2.93	3.08	2.75	<.09
Home economics & comfort	2.75	2.81	.33	<.56
Thermal science	2.66	2.83	2.74	<.10
Agriculture & transportation	3.05	3.10	.25	<.61

a/ The disciplines were rated on a 4 point scale for knowledge and need with 4 indicating maximum value.

b/ With 1 and 138 df.



TABLE XXI

A COMPARISON OF GAP (TRAINING REQUIREMENT) IN SELECTED ENERGY DISCIPLINES WITH AMOUNT OF WORKTIME IN ENERGY OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

DISCIPLINE	MEAN GAP <sup>a/</sup> by Worktime in Energy		F	P
	Below average (under 50%)	Above average (50% & over)		
HVAC & buildings	-.76	-.62	.10	<.75
Economics & management	-.57	-.37	2.99	<.08
Home economics & comfort	-.36	-.28	.41	<.52
Thermal science	-.31	-.29	.01	<.93
Agriculture & transportation	-.50	-.73	2.01	<.15

a/ The mean gap represents the differences between knowledge and need. the larger the negative value the greater the training requirement.

b/ With 1 and 138 df.

SUMMARY OF DIFFERENCES IN KNOWLEDGE, NEED, AND GAP IN SELECTED ENERGY DISCIPLINES BY SELECTED CHARACTERISTICS OF EXTENSION PROFESSIONALS

Age. A comparison of training requirement (gap) (Table XXII) of agents revealed that only one discipline, home economics and comfort, was statistically significantly different. There was also a statistically significant difference for need in home economics & comfort and in the thermal sciences disciplines.

Sex. The training requirement (gap) of agents were statistically significant different in all disciplines except home economics & comfort. Only in the discipline of home economics & comfort was there a statistically significant difference in the need for including the disciplines in the curriculum. Men and women had statistically significant differences in their knowledge level on all of the disciplines.

TABLE XXII

A SUMMARY COMPARISON OF KNOWLEDGE, NEED, AND GAP IN SELECTED ENERGY DISCIPLINES WITH SELECTED CHARACTERISTICS OF EXTENSION PROFESSIONALS DOING ENERGY WORK, SOUTHERN REGION AND ENERGY PILOT STATES OF THE UNITED STATES, 1981

PERSONAL CHARACTERISTICS	Statistical Significance of Dependent Variables by Discipline <sup>1/</sup>														
	HVAC & buildings			Economics & management			Home economics & comfort			Thermal science			Agri-culture & transportation		
	K <sup>2/</sup>	N <sup>3/</sup>	G <sup>4/</sup>	K <sup>2/</sup>	N <sup>3/</sup>	G <sup>4/</sup>	K <sup>2/</sup>	N <sup>3/</sup>	G <sup>4/</sup>	K <sup>2/</sup>	N <sup>3/</sup>	G <sup>4/</sup>	K <sup>2/</sup>	N <sup>3/</sup>	G <sup>4/</sup>
Age	X	X	X	X	X	X	X	S	S	X	S	X	X	X	X
Sex	S	X	S	S	X	S	S	S	X	S	X	S	S	X	S
Educational background	S	X	S	S	X	S	S	S	X	S	X	S	S	X	S
Geographic region	X	S	S	X	X	S	S	S	X	S	X	S	X	X	X
Work assignment	S	X	S	X	X	S	S	S	X	S	X	S	S	X	S
Tenure in Extension	X	X	X	S	X	X	X	X	X	X	X	X	X	X	X
Tenure in Extension energy work	X	X	S	X	X	X	X	S	X	X	X	X	X	S	X
Percent of worktime in energy	X	X	X	S	X	X	X	X	X	X	X	X	X	X	X

1/ S indicates statistically significant differences at the .05 level, an X indicates no statistically significant difference at the .05 level.

2/ Knowledge level in discipline.

3/ Necessity for including discipline in curriculum.

4/ Gap or requirement for training in discipline.

Educational Background. The findings for agents with different educational backgrounds with regard to knowledge, need, and gap on all disciplines were similar to that of agents when grouped by sex.

Geographic Region. In comparing the training requirement (gap) of agents from different geographic regions there were statistically

significant differences in HVAC & buildings, economics & management, and thermal science.

Agents expressed large need differences in the disciplines of HVAC & buildings and home economics & comfort. The knowledge of agents varied enough in home economics & comfort and thermal science disciplines to make it necessary to alter the training program to account for these knowledge differences.

Work Assignment. The training requirement (gap) of state and county staff workers revealed that the null hypothesis should be rejected for four of the five disciplines. The need of the state and county workers varied statistically significantly only in home economics & comfort. However, the knowledge of agents was statistically significantly different in all disciplines except economics & management.

Tenure in Extension. The Extension experience of agents had no statistically significant relationship with training requirement gap, need, and knowledge for curriculum development except in one area. The differences in knowledge of economics & management were statistically significant at the .05 level.

Tenure in Extension Energy Work. The training requirement (gap) of agents was statistically sufficiently different in only one discipline, HVAC and buildings.

Agents expressed a significantly higher need for including the disciplines agriculture & transportation, and home economics & comfort in the training program.

Amount of Worktime. Comparing groups of agents with different

percents of worktime devoted to energy for training requirement (gap), need, and knowledge revealed no statistically significant difference except in the knowledge of agents in economics & management.

#### Conclusions on Findings

Educators using the curriculum should recognize that groups of agents have major differences in knowledge, need, and training requirements (gap). These variations were singled out in the study and should be given prime consideration when implementing the in-service training curriculum.

## Chapter VI

### A RECOMMENDED CURRICULUM IN ENERGY CONSERVATION

The basic information for developing the curriculum in energy conservation was obtained from the research findings in this study. An analysis of Extension agents' knowledge, need, and gap of energy subject matter concepts grouped into five disciplines compared with their personal characteristics yielded the educational requirements of the audience. These findings were the primary input used to formulate the general and specific teaching objectives contained in the energy conservation curriculum.

#### Source of Educational Objectives

Current literature offered valuable insights into the contemporary life and educational priorities in the field of energy conservation, but the main educational objectives were derived from the participants (learners) and the subject matter specialists.

An analysis of the Extension agents' characteristics provided several personal and job-related features which could have an influence on the selection of learning experiences and training. The ultimate training requirements of the agents constituted the curriculum ingredients based on the behavior-content approach to developing educational objectives suggested by Tyler (42).

#### Personal Characteristics of the Learner

Frequency distributions of independent variables were used to

determine range and mean for age, Extension experience, energy work experience, and amount of worktime devoted to energy by Extension workers. The means and ranges of independent variables were useful in categorizing individual groupings.

Additional features of respondents - sex, educational background, work location, and geographic region - proved valuable for grouping of males and females, area of educational expertise, geographic regions of the United States, and work duties of workers all having meaningful implications for this study.

#### Philosophy of Extension as it Relates to Energy Conservation: A Screen for Educational Objectives

The main goal of Extension in energy conservation is to adequately train and prepare agents in the field of energy education so that they can impart knowledge and help their clientele's effectiveness in making decisions concerning the wise and efficient use of energy. Such a goal is closely tied to Extension's comprehensive philosophy of (13) helping people to help themselves, conducting educational programs on an informal basis, making use of volunteer lay leaders, and basing educational programs on current needs. Extension also makes use of current research in developing educational programs in energy education.

Even though energy conservation is relatively new to Extension, the implementation of Extension education in this area is important because energy use and cost affect literally everyone. Energy education is disseminated by working with individuals, groups, and communities in the same way Extension has approached agriculture, home economics,

youth, and community problems for many years. While energy may be considered a new field, it is anticipated that it will become an equally important Extension program in the future.

The feeling of the agents in the 20 states being studied indicated that energy conservation was an important area of responsibility for Extension. With these expressed requirements in mind, an in-service curriculum designed to increase agents' competence in energy conservation was constructed according to the philosophical guidelines of Extension.

#### A Psychological Screen for Educational Objectives

Educational objectives for energy education should meet certain criteria established through the psychology of learning. The objectives should be screened according to the necessity and knowledge of the learner. The following criteria expressed by Francois (13) were helpful:

1. The educational objective should be stated at a level that is consistent with knowledge and need of agents.
2. Behavioral changes implied by the objectives should be attainable by the agents.
3. Objectives should be limited to an attainable number in the given time.
4. Accomplishment of the objectives should provide agents with enhanced ability in problem identification and problem solving.
5. The objectives should allow the knowledge gained in one experience to be transferred to other problems or situations.
6. The objectives should afford ample practice and repetition of experiences, concepts, and disciplines learned.

### The Curriculum

The questionnaire consisted of 24 energy concepts, but for evaluation purposes the concepts were classified into five major disciplines. The categorization of concepts to disciplines were as follows:

- I. Heating, ventilating, air conditioning (HVAC) and buildings
  - Building design and construction
  - Heating
  - Control systems
  - Ventilation and air filtration
  - Refrigeration and air conditioning
- II. Agriculture and transportation
  - Agriculture production practices
  - Transportation and power vehicles
- III. Economics and management
  - Payback analysis
  - Energy conservation and quality of environment
  - Energy costs, trends, and environmental effects
  - Terminology
  - Primary structures
  - Energy management programs
  - Production of energy
  - Energy measurements
- IV. Home economics and comfort
  - Landscaping
  - Food processing



Lighting

Comfort and environment factors

V. Thermal science

Energy recovery

Heat transfer

First law - thermo-dynamics

Second law - thermo-dynamics

Psychrometrics

A general curriculum in energy education was developed with knowledge, need, and gap of subject matter given major consideration. The philosophical and psychological screens were applied formulating a practical curriculum.

The sample curriculum, along with general and specific teaching objectives, is supported by the research findings in this study. The curriculum is divided into five selected disciplines in energy. These were evaluated for need, knowledge, and gap, and their relationship to age, sex, educational background, geographic region, work assignment, tenure in Extension, tenure in Extension energy work, and amount of worktime devoted to energy.

The curriculum may be implemented as written but should be tailored to the users' need. Users of the curriculum should recognize that the general objectives serve as guides to the selection and organization of specific teaching objectives and learning experiences and offer direction for measuring and evaluating the criteria of objectives selected. General and specific teaching objectives suggest

the learning activities and instructional resources that should be utilized in the program.

To implement the sample curriculum, a detailed instructional outline should be developed to suit the requirements of the user organization. The five disciplines could be used as separate instructional units. A thorough review of the disciplines, concepts, and teaching objectives should be considered as a beginning point in the instructional process. Since statistically significant differences were found in a large number of variables it is important that the educators refer to the findings in Chapter V to tailor the training to meet the particular requirements of their constituents.

Subject matter selected to be included in the in-service sample curriculum consisted of those disciplines (concepts) that had a minimum need mean value of 2.5 and a negative gap (training requirement) value. The determination on the first criterion was made by evaluating the agents' response as to the need for the concept (discipline) to be included in the training program. The need was evaluated with 1 representing little or no necessity and 4 indicating maximum necessity. A 2.5 need mean represented the mid-point of the measurement scale.

The second criterion taken into consideration in determining which disciplines (concepts) were to be included in the training program was the gap. The gap was determined by subtracting the mean need from the mean knowledge value. The larger the negative gap value the greater the need exceeds the knowledge, resulting in a greater training requirement for agents.

All disciplines and concepts had need mean scores above 2.5 and gap values in the negative range, with one exception. Within the discipline of thermal science the concept psychrometrics had a positive score, but since the thermal science discipline meet the minimum requirement psychrometrics was included in the curriculum in addition to all other concepts and disciplines.

#### SAMPLE CURRICULUM

Discipline: Heating, ventilating, air conditioning (HVAC) and buildings

General objective:

Extension professionals in energy conservation work to gain an understanding of the concepts in the discipline of HVAC and buildings.

Specific teaching objectives:

Extension agents in energy work to participate in a training program to:

1. Gain an understanding of building design and construction and its effect on energy conservation.
2. Gain an understanding of heating and its effect on energy conservation.
3. Gain an understanding of control systems and their effect on energy conservation.
4. Gain an understanding of ventilation and air filtration and its effect on energy conservation.
5. Gain an understanding of refrigeration and air conditioning and its effect on energy conservation.

Major concepts and definitions

1. Building design and construction - the design and construction of buildings with particular attention given to aspects which affect energy consumption.
2. Heating - maintaining a space at a temperature above that of its surroundings, including the equipment required to accomplish the task.
3. Control systems - systems of devices and controls integrated to govern the operating of the energy consuming equipment, particularly heating, ventilating, and air conditioning systems.
4. Ventilation and air filtration - supplying outside air and removal of inside air to provide satisfactory conditions, including fans and duct work which provided forced circulation of air. Removing from the air undesirable contaminants such as dust, smoke, pollen, and odors, including equipment to perform the task.
5. Refrigeration and air conditioning - maintaining a space at a temperature below that of its surroundings, including the equipment required to accomplish the job.

Discipline: Agriculture and transportation

General objective:

Extension professionals in energy conservation work to gain an understanding in the discipline of agriculture and transportation.

Specific teaching objectives:

Extension agents in energy work to participate in a training

program to:

1. Gain an understanding of agricultural production practices and their effects and relation to energy conservation.
2. Gain an understanding of transportation and power vehicles and their effect on energy conservation.

Major concepts and definitions:

1. Agricultural production practices - production practices in agriculture and their relationship to energy use.
2. Transportation and power vehicles - the operation and maintenance of power-driven vehicles as related to energy conservation.

Discipline: Economics and management

General objective:

Extension professionals in energy conservation work to gain an understanding in the discipline of economics and management.

Specific teaching objectives:

Extension professionals in energy to work to participate in a training program to:

1. Gain an understanding of payback analysis and its effect on energy conservation and feasibility.
2. Gain understanding and knowledge of energy conservation and quality of the environment as it affects the preservation and care of natural resources.
3. Gain an understanding of energy costs, trends, and environmental effects of energy conservation.

4. Gain an understanding for terminology used in energy work.
5. Gain an understanding of pricing structures, such as utility bills and charges for energy consumption.
6. Gain an understanding of energy management programs as they relate to energy conservation.
7. Gain an understanding of the sources and methods of the production of energy and their effects on energy conservation.
8. Gain an understanding of instrumentation and methods used in measuring energy and their effect on energy conservation.

Major concepts and definitions:

1. Payback analysis - a method of determining if an energy conservation measure is economically feasible.
2. Energy conservation and quality of the environment - the care and preservation of natural resources.
3. Energy costs, trends, and environmental effects - the cost of energy from both monetary and environmental standpoints and the effects that it has on these costs.
4. Terminology - technical or special terms used in energy education work.
5. Pricing structures - the component parts of utility bills and the rationale behind each component.
6. Energy management program - the management of energy conservation programs.
7. Production of energy - the production, amount and types of energy sources and reserves.

8. Energy measurements - instrumentation and methods used in measuring quantities of energy.

Discipline: Home economics and comfort

General objectives:

Extension professionals in energy conservation work to gain an understanding in the discipline of home economics and comfort.

Specific teaching objectives:

Agents in energy work to participate in a training program to:

1. Gain an understanding of landscaping designs to conserve energy.
2. Gain an understanding of food processing and its relationship to energy conservation.
3. Gain an understanding of the use of lighting for energy conservation.
4. Gain an understanding of environmental factors that influence comfort and energy conservation.

Major concepts and definitions:

1. Landscaping - the arrangement of plants and structures to promote energy conservation.
2. Food processing - food processing practices and their relationship to energy use.
3. Lighting - the illumination of an area by either artificial or natural means, and the equipment needed to accomplish the job.
4. Comfort and environmental factors - the physiological and

psychological factors influencing a person's perception of a comfortable condition.

Discipline: Thermal science

General objectives:

Extension professionals in energy conservation work to gain an understanding of the thermal science discipline.

Specific teaching objectives:

Agents in energy work to participate in a training program to:

1. Gain an understanding of recovering energy for energy conservation.
2. Gain an understanding of heat transfer and its application to energy conservation.
3. Gain an understanding of the second law of thermodynamics or quality of energy as it relates to energy conservation.
4. Gain an understanding of the first law of thermodynamics as it relates to energy conservation.
5. Gain an understanding in psychrometrics as it affects energy conservation.

Major concepts and definitions:

1. Energy recovery - to recover energy from waste materials, discharges, and recycleable products.
2. Heat transfer - the transfer of energy due to temperature differences including mass transfers involving temperature differences.
3. Second law of thermodynamics - the amount of work which can be derived from a given quantity of energy to determine the



best use that can be made of a given amount and kind of energy, and to determine the limitations of how that energy may be used.

4. First law of thermodynamics - energy is neither created nor destroyed; it is only changed in form. This yields the equation  $\text{Energy in} = \text{Energy out} + \text{change of energy stored}$ .
5. Psychrometrics - a study of the relationship between wet and dry bulb temperatures and its bearing on the amount of water vapor in the air.

### Learning Experiences

Flint (12) pointed out that educational objectives provide the basis for developing learning experiences and evaluation procedures. Learning experiences guide learners toward attainment of the objectives. Tyler (42) suggested the following general principles for selecting learning experiences:

1. For a given objective to be achieved, the learner must have experiences that give him the opportunity to practice the kind of behavior implied by the objective.
2. The learning experiences must be such that the student obtains satisfaction from the behavior.
3. The reactions desired in the experiences should be within the realm of possibility of the learner.
4. Many different experiences can be used to achieve a given objective.
5. A given learning experience can result in several different outcomes.

Learning experiences selected with these principles in mind are more apt to be successfully accomplished.

To effectively plan learning experiences for Extension agents the education should follow the specific criteria for fulfillment of educational and teaching objectives as outlined by Flint (12).

Applied to Extension's needs the criteria are:

1. Long range goals must guide work for several years, but a specific amount of work must be achievable on a yearly basis.
2. Disciplines should be applicable to a relatively large number of agents.
3. Disciplines must be achievable and useful in the plan of work needed by the people being served.
4. Persons who are to participate, the behavioral change desired, and subject matter in which behavioral change is to occur should be indicated.
5. Audience to be reached should be identified by one or more of the following categories: a) age, b) sex, c) tenure in Extension, d) tenure in Extension energy work, e) educational background, f) geographic region, g) work location, h) amount of time devoted to energy.

#### Implementation of Curriculum

When implemented the curriculum suggested in this report would improve competence and satisfy the training requirements of Extension agents working in energy education and conservation. Learning experiences to fulfill the educational objectives in the five major energy disciplines may be presented to the learners in a variety of approaches. The most realistic and practical approach is incorporating

the learning activities into an in-service training curriculum supported by Extension orientation sessions or regional training workshops. These methods are presented for consideration.

#### In-Service and Orientation Training

The curriculum was developed with in-service training as the primary means of implementing the education. Ideally, the in-service training should be flexible, continuous, and of short duration not to exceed three weeks. Another acceptable method would be for the training to be conducted for one week held periodically. The various disciplines presented in the curriculum could serve as individual training units. The curriculum developed is general and inclusive of many areas, so the organizers of the in-service program should be highly selective in choosing the learning activities and educational and teaching objectives to be included.

Another possible approach to training of new Extension personnel would be to include energy conservation in the orientation program. The orientation process could provide new staff members with an awareness and understanding of concepts and principles concerning energy education work. However, this type of training would not be available to agents already in the system, and would provide only limited exposure to those receiving the orientation course.

#### Regional Workshops

Regional workshops for Extension personnel are another means of implementing the energy training curriculum. These workshops could

be held annually or more frequently within designated regions identified in this study. The research findings indicated differences peculiar to regions for training in the selected areas of energy. Extension specialists, research personnel, and other professionals with expertise in energy conservation could conduct the workshops. One drawback to this method is the limited number of participants that could be accommodated.

### Evaluation

To determine if the curriculum objectives have been attained, a summative evaluation should be initiated as suggested by Tyler (42) to accomplish the following purposes: to measure the behavioral changes, to identify strengths and weaknesses of the program, to point out areas that need further attention, and to reveal information about the success of the curriculum. The program ideally should start by determining the learner's attitude, interest, understanding, and knowledge. Following the pre-evaluation, a mid-point evaluation would assess progress and serve as an indicator of adjustments needed in the design and organization of learning experiences. The final phase of the evaluation deals with assessing terminal behavior indicating the extent of behavioral change (learning) that has taken place. The formative evaluation in this paper refers to the appraisal which occurred at each major step during the development of the curriculum. These included, sources for obtaining educational concepts and objectives, screens for selection of objectives, selection and organization, arriving at general and teaching objectives, and planning lessons for learning experiences.

## Chapter VII

### SUMMARY AND CONCLUSIONS

Energy conservation is one of the major educational programs under consideration by Extension. The facts that energy education is relatively new and that the current in-service training programs fail to meet the needs of agents engaged in energy education work leaves the Extension Service less than fully prepared to meet the critical need to furnish energy information to the general public. Continued professional improvement, through in-service training, is essential to keep pace with the rapid advancement of energy technology and social changes in our modern society. It is anticipated that energy conservation work will soon become part of the work assignment of all Extension agents. Most agents received their formal education in agriculture, home economics, or related biosciences and usually are committed to the traditional areas of Extension work - agriculture, home economics, youth, and rural development. The agents in the physical sciences area (engineering) should pave the way to help Extension introduce an energy conservation program equal to that of existing programs.

The scope of the study included finding the knowledge level, need, or importance of certain disciplines in the program and the training requirements of agents for selected energy disciplines and concepts.

The major objective of the study was to develop a curriculum

for in-service training of Extension professionals involved in energy conservation. A conceptual model integrating selected agents' characteristics, knowledge levels, need for including selected concepts in the curriculum, and training requirement (gap) of Extension professionals on five energy disciplines was developed to provide a framework for the in-service training in energy education. The curriculum was designed to give agents an understanding of broad disciplines and principles in energy conservation so that they could work comfortably in this field of education. It was felt that the training should be accomplished in a reasonable length of time, not exceeding three weeks. The assumption was also made that agents to be trained would have the necessary training in Cooperative Extension Service philosophy.

The study included 20 states: the 10 energy pilot states and the remaining 10 states of the Southern region. The 10 pilot states were Connecticut, Michigan, New Mexico, Pennsylvania, Washington, Wisconsin, Wyoming, Alabama, Tennessee, and Texas. The last three states mentioned, together with the states of Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, and Virginia, formed the Southern Extension region. Data were provided by 149 agents through a questionnaire survey. The information was analyzed in four areas - 1) distribution of personal and job-related characteristics, 2) analysis of knowledge level, 3) analysis of the need for a discipline in the curriculum, and 4) analysis of gap between knowledge level and expressed need for training.

Personal and job-related characteristics including age, sex, tenure in Extension and energy work, educational background, work location, and time devoted to the job were taken into account to develop the curriculum. Frequency distributions of these independent variables were used to identify the characteristics of the agents for whom the in-service training was developed.

The second part of the analysis dealt with the knowledge level. The third part analyzed importance or need of disciplines to be included in the training program and was followed by the evaluation of the gap between knowledge level and expressed need for training in selected energy concepts. These analyses dealt with the dependent variables of knowledge, need, and gap and compared them with independent variables - age, sex, educational background, geographic area, work location, tenure, and worktime in the job. The dependent variables were evaluated for each of the 24 concepts and analyzed in detail for the concepts grouped in five major discipline areas.

The 24 concepts used in the curriculum were categorized into five disciplines. The five major energy-related disciplines studied were: 1) heating, ventilating, air conditioning (HVAC) and buildings; 2) economics and management; 3) home economics and comfort; 4) agriculture and transportation; and 5) thermal science.

### Statistical Analysis

The relative importance of disciplines to be included in the training program was determined by comparing their mean ratings.

An analysis of variance using the F test furnished a measure of significance of the difference between means. The participants were

grouped according to the following independent variables: 1) age, 2) sex, 3) educational background, 4) geographic regions, 5) work assignment, 6) tenure in Extension, 7) tenure in Extension energy work, and 8) percent of worktime devoted in energy, and tested for statistically significant differences in their responses.

Mean scores were computed for each independent variable. Agents were asked to indicate their knowledge level of each concept and the need for including the concept in a training curriculum. The same four-point scale used in the questionnaire was utilized in the analysis. A rating of 1 represented little or no knowledge and 4 indicated maximum knowledge. A similar scale was established to ascertain the need for including disciplines in the training program with 1 representing the least amount of need and 4 expressing utmost need. The gap rating was calculated by subtracting the need (mean) from the knowledge (mean) value for groups being compared. A negative value denoted that the need for the concept exceeded the knowledge level, and a positive value represented the reverse. The larger the negative value, the greater the gap between need and knowledge. A comparison was then made of the different groups' response in the five energy disciplines.

The null hypotheses applied to this study were that for all independent variables there are no statistically significant differences on mean scores of the groups for knowledge level, need for including training, or gap in the five energy disciplines. The level of statistical significance selected for rejecting the null hypothesis was .05.



## SUMMARY OF THE FINDINGS

### Characteristics of Extension Professionals

The mean age of agents engaged in energy work was 40 years. The range in age was 25 to 63 years of age. Slightly over two-thirds (69 percent) were men and less than one-third (31 percent) were women.

Some 50 percent of all agents received their education in the social sciences (including Extension education) and slightly less than one-third (32 percent) received their training in the physical sciences (including engineering). Nearly half the group were from the Southern Coastal states while the Intermediate and Northern regions each had approximately one-fourth of the participants.

Over 50 percent of the respondents had been in Extension work for less than 10 years. The mean tenure for all agents was 10 years. Nearly half the agents had done energy work in Extension less than three years. The mean tenure for all agents in energy work was three years. Some 59 percent of all participants spent 50 percent or more of their worktime doing energy work.

An overall analysis of knowledge, need, and gap in the five major energy disciplines indicated that agents' knowledge level in the discipline of heating, ventilating, air conditioning (HVAC) and buildings was the highest (2.58), with economics and management having the second level of knowledge (2.55). These mean values indicated that agents had a knowledge level ranging between knowledgeable and somewhat knowledgeable. The knowledge scores for all disciplines did not vary greatly; nevertheless, agriculture and transportation, and thermal science were accorded the lowest scores (2.42 and 2.44), a rating just

below the mid point of the knowledge scale. Home economics and comfort was the closest discipline to the middle of the knowledge scale with a 2.48 mean score.

Agents expressed more variation for need to include disciplines in training with HVAC and buildings, agriculture and transportation, and economics and management having mean values above 3 which signified a rating between very necessary and necessary. However, the need scores for the disciplines in home economics and comfort (2.79 mean) and thermal science (2.74 mean) represented a lower value reading between necessary and somewhat necessary. Agents had the greatest requirement for training (largest gap) in the disciplines of HVAC and buildings (-.64 mean) and agriculture and transportation (-.63 mean). A much smaller gap was found in the disciplines of thermal science (-.30 mean) and home economics and comfort (-.31 mean) indicating that participants had less training requirement in those areas. When compared with the other disciplines, the gap in economics and management (-.46 mean) was somewhere in the middle.

The relationship of knowledge, need, and gap was used to develop the curriculum based on agents' evaluation of energy related disciplines by selected personal characteristics of age, sex, educational background, geographic area, work location, tenure, and worktime in the job. A summary of the analysis of variables to determine training requirements of agents follows.

Age - There were no statistically significant differences found in knowledge level on the basis of age. However, when the same test was applied to need, a statistically significant difference was

noted. The older agents expressed a higher need in home economics and comfort (2.92 mean) and thermal science (2.86 mean) than the younger group which had mean values of 2.66 and 2.63 respectively.

Older agents had a larger gap (training requirement) level (-.49 mean) than the lower gap (-.18 mean) signified by the younger group in the discipline of home economics and comfort.

Sex - The knowledge level of men exceeded considerably that of women in four of the five disciplines. However, women had a higher knowledge score (2.82 mean) than men (2.32 mean) in the discipline of home economics and comfort.

Even though women had a higher knowledge level than men, they still expressed a greater need for including training in home economics and comfort.

Females had a much higher gap (training requirement) in four of the five disciplines. Only in home economics and comfort did men and women have the same training requirement (gap) (-.30 and .33 means).

Educational Background - Agents with different educational backgrounds had statistically significant differences in their expressed knowledge for all disciplines tested. The greatest amount of knowledge variation appeared with agents in the humanities field as their low mean was in the middle of somewhat knowledgeable, whereas the physical science group was on the middle to top part of the knowledge scale, with one exception - the physical science agents were only somewhat knowledgeable in the field of home economics and comfort.

Because of the high necessity score expressed by the social

science group (3.02 mean) in the discipline of home economics and comfort compared with the lower somewhat necessary value of the physical science agents (2.47 mean), the variation was statistically significant.

The gap values for agents of various backgrounds indicated that statistically significant differences were found in four of the five disciplines being studied - HVAC and buildings, economics and management, thermal science, and agriculture and transportation.

Geographic Region - In comparing the knowledge level of agents from different geographic regions there was found to be statistically significant differences in home economics and comfort and thermal sciences. Agents in the Southern region had a knowledge level score just above the mid-range (2.61 mean) and the Northern region had the lowest value (2.32 mean), somewhat below the middle of the knowledge scale for the discipline in home economics and comfort. However, agents from the Southern Coastal region had a low score (2.28 mean), a somewhat knowledgeable range compared with the higher knowledgeable value (2.66 mean) expressed by the agents from the Intermediate area for the thermal science discipline.

The largest need difference was found in the discipline of home economics and comfort where agents from the Southern Coastal region expressed a high need (3.03 mean) value when compared with the lowest (2.54 mean) in the Northern region. Very similar need differences were noted in HVAC and buildings where the Southern Coastal group had a need value of 3.33 (mean), while the agents in the Northern region had a lower reading of 3.03 (mean). In the disciplines of

economics and management, thermal science, and agriculture and transportation, the agents from all regions agreed that these disciplines had similar priorities as to the need for including them in a training program.

The findings implied that the requirement for training (gap), in the disciplines of HVAC and buildings, thermal science, and economics and management are different and peculiar to each geographic area. The hypothesis of no differences was not rejected for the training needs (gap) of agents from different regions in the disciplines of home economics and comfort and agriculture and transportation.

Work Assignment - The discovery was that state staff employees had higher knowledge scores in HVAC and buildings, economics and management, thermal science, and agriculture and transportation when compared with values of county staff workers in a proportion justifying statistically significant dissimilarity. However, in the discipline of economics and management the difference did not substantiate statistical significance as in the four other disciplines. Home economics and comfort was the only discipline that county staff workers expressed as statistically significant with a variation that was higher in knowledge (2.61 mean) when compared with state staff people who recorded a knowledge level of only 2.40 (mean).

The need of state and county staff workers varied statistically significantly only in home economics and comfort. Accounting for the large divergent score was the county staff's high need (3.0 mean), compared with the lower need (2.66 mean) expressed by state staff people. The two groups of agents found that they had quite similar need differences in the other four disciplines in the study.

An analysis of the gap revealed that the hypotheses should be rejected on four of the five disciplines. These findings indicate that training requirements of agents are different for HVAC and buildings, economics and management, thermal science, and agriculture and transportation.

Tenure in Extension - There was no statistically significant difference in knowledge, need, and gap relative to agents' experience in Extension except in one area. Agents with less experience were found to possess more knowledge (2.66 mean) in economics and management than their more experienced counterparts who expressed a lower knowledge value (2.42 mean). The differences in knowledge were statistically significant at the .05 level.

Tenure in Extension Energy Work - The research findings revealed that years of experience in Extension energy work had no bearing on the expressed knowledge level of agents in any of the five energy disciplines.

The data implied a statistically significant difference in need as less experienced workers expressed a higher need value (3.22 and 2.94 means) for including disciplines in agriculture and transportation, and home economics and comfort, in the training program while agents with more experience indicated a lower need value (2.94 and 2.70 means) for the two disciplines.

The gaps or training requirements of less experienced agents were generally higher than those of the more experienced group. However, only in one discipline, HVAC and buildings, were these variations large enough to be statistically significant ( $p < .02$ ). The

training requirement (gap) for the other four disciplines did not vary enough to be meaningful when energy Extension work experience is the criteria for evaluation.

Amount of Worktime - Agents with a higher percent of worktime devoted to energy had a statistically significant higher knowledge score (2.71 mean) in economics and management than the lower value (2.35 mean) expressed by agents who devoted less time to energy work. These findings suggest to the user of the curriculum that there are meaningful knowledge differences between the two groups of agents in teaching the discipline of economics and management.

When comparing the need and gap of agents as to percent of worktime each group devoted to energy work, the findings support the null hypothesis of no statistically significant differences in any of the five disciplines that were included in the research.

### Conclusion

The study revealed that agents had a need for including all the concepts and disciplines studied in the curriculum. Equally important was the finding that agents had a training requirement in all concepts and disciplines. Since the agents surveyed represent a cross section of the United States, it would be logical for each state Extension Service to consider including energy conservation as part of this educational thrust. In view of these findings, energy should be an increasingly important part of Extension's educational programs. The following conclusions have application not only for the 20 states in the study but for the entire nation.

Age. There was no need for planning different types of training programs for agents in different age groups in four of the five disciplines. However, when training requirements for home economics and comfort were determined, there were differences significant enough to recommend different approaches for meeting the training demands of the younger and older groups. The older group expressed a greater training requirement, so more information should be given to them on home economics and comfort.

Sex. Women were more knowledgeable than men in the discipline of home economics and comfort. On the other hand, men responded at a higher knowledge level than women in HVAC and buildings, economics and management, thermal science, and agriculture and transportation. In all cases women had greater training requirements than men. A reasonable conclusion is that the meaningful differences in the responses of men and women could be attributed to their educational background and training. Generally, women have educational and training background more suited to prepare them to be more knowledgeable than men in the discipline of home economics and comfort. On the other hand, the training that men receive usually prepares them to respond at a higher knowledge level than women in the other four disciplines.

Educational Background. Agents in physical sciences had smaller training requirements in all disciplines when compared with agents of other educational backgrounds, and these differences were significant in all disciplines except in home economics and comfort. People in physical sciences would be expected to have greater knowledge in disciplines such as HVAC and buildings, economics and management,



thermal science, and agriculture and transportation. This supports the thinking that individuals want more training in the subjects of which they have more knowledge.

Geographic Region. Agents from different geographic regions had meaningful differences in training requirements in the disciplines of HVAC and buildings, thermal science, and economics and management. These differences are not totally surprising because agents in the Northern region would be expected to have a greater training requirement in concepts such as heating than agents from the Southern region. The reverse training requirement might be expected in psychrometrics because agents in the Southern region need to deal with concepts such as moisture and humidity more often than agents from the other regions where these present less of a problem.

Work Assignment. Important differences were found in agents' training requirements for the disciplines of HVAC and buildings, economics and management, thermal science, and agriculture and transportation. This suggests curriculum modification for state and county staff workers in the four disciplines would be helpful in training the two groups of agents. In these disciplines the county field personnel had greater training requirements, probably because experience and educational background did not prepare them as well for an energy assignment as the specialist.

Tenure in Extension. The amount of time an agent has been employed in Extension has no influence on the ultimate training requirement in any of the five major disciplines studied. Since the training requirements of agents with different tenure do not vary

significantly the user can plan the same type of training program for the two groups.

Tenure in Extension Energy Work. Less experienced agents had greater training requirements in all disciplines when compared with the more experienced group. The findings revealed that only in the discipline of HVAC and buildings were these training requirements sufficiently substantial to be meaningful. In that discipline the less experienced agents should be given more intensive training.

Amount of Worktime. Agents with a higher percentage of their worktime devoted to energy had training requirements equal to their counterpart group. Modification of training for agents with different amounts of worktime devoted to energy would not be essential since both groups had the same training requirements.

#### Implications for Extension Education

Extension employees working in the field of energy conservation education can receive the proper training needed to improve their competence in their job by successfully completing the curriculum suggested in this research paper. Learning experiences designed to fulfill the teaching and educational objectives recommended in this study may be presented to the learners by using the in-service training curriculum proposed.

Training requirement of agents will vary with different work assignments or with changes of job responsibility, as these will cause the necessity and importance of discipline to change. The curriculum is general and flexible enough to allow adjustment for in-service

training of agents to meet the expressed training requirement of the individual or group being considered for education. The study identified the fundamental concepts required of Extension agents engaged in energy conservation education.

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## APPENDICES

APPENDIX A

Director Loupe's Letter

Letter to Panel of Experts

Letter to Agents to Complete Questionnaire

Questionnaire

January 29, 1981

Mr. Daniel Fontenot, Jr., Associate Specialist in Energy for the Louisiana Cooperative Extension Service, is planning to do a study to develop an energy educational curriculum for Extension professionals. The result of the study will be made available to you and should be useful to administrators and energy Extension people. The study will be done through a questionnaire to be administered to Cooperative Extension workers at state and county levels who devote considerable time to energy. In most states, the study will be done with a small group.

Mr. Fontenot talked by telephone to a member of your staff concerning the energy study. The specialist expressed an interest and his willingness to cooperate. Please talk this over with your staff and designate a liaison person for your state.

The liaison person will be asked to:

Identify the Extension workers, at both specialist and county level, who spend a considerable amount of time in energy.

Disseminate questionnaires to energy Extension workers.

Get respondents to complete questionnaires.

Return completed questionnaires to Mr. Fontenot.

The study will help develop an energy curriculum (in-service or otherwise) for Extension professionals. I would appreciate getting your approval for this project and confirmation of the liaison contact person.

Your cooperation and help would be greatly appreciated.

Sincerely,

Denver T. Loupe  
Vice-Chancellor and Director

PANEL OF EXPERTISE COMMITTEE  
FOR  
DANIEL FONTENOT, JR.

A RESEARCH PAPER FOR  
DEVELOPING A CURRICULUM FOR IN-SERVICE  
TRAINING OF EXTENSION AGENTS ASSIGNED  
TO ENERGY CONSERVATION EDUCATION

Dr. Jon Wert, PA  
Dr. Horace Hudson, GA  
Dr. Don Price, FL  
Mr. Joe Smilie, LA

I am sending you an advance questionnaire so that you can indicate the degree of necessity you feel that the energy concepts should have in the in-service training curriculum for Extension Energy workers.

At the end of the questionnaire, you may add concepts not included that you feel merit consideration.

Purpose:

The intent of this study is to develop an in-service energy training curriculum for Extension workers. We are assuming that the agents to be trained will have already received the necessary training in Cooperative Extension Service philosophy. The study will only deal with the subject-matter content in energy. The scope of the curriculum should be general enough to permit each state some flexibility in selecting or altering the subject matter to include area needs in the training curriculum.

The training should be directed to give agents a fundamental background including basic principles and technologies in energy conservation.

Page 2

The curriculum is intended to be taught in short courses or training sessions and the total training time should not exceed three weeks.

The training material in energy is much too extensive; therefore, the author will attempt to develop an energy curriculum containing only the most essential energy concepts to be included in the training.

Please note the enclosed questionnaire and indicate the degree of necessity you feel that each energy concept should have in the in-service training curriculum for Extension Energy workers. Further instructions are included with the questionnaire.

A prompt reply would be helpful and appreciated.

Sincerely,

Daniel Fontenot, Jr.  
Project Coordinator  
Associate Specialist  
Louisiana State University

Dear Extension Professional,

Your energy coordinator and Extension director are cooperating with the Louisiana Cooperative Extension Service in conducting a study for the purpose of developing a curriculum for in-service training of Extension professionals assigned to energy work. Results of this study will provide a basis for establishing a much needed training program for workers involved in energy. In order that the study may be accomplished, certain information must be provided by Extension professionals from the ten energy pilot states and the thirteen southern states.

Attached is a copy of the questionnaire designed to provide much of the information required to develop the training curriculum. Please make a contribution to the study by taking a few minutes of your time to complete this questionnaire.

The success of the study hinges upon your prompt and fair evaluation to all questions. Your responses will be coded into an anonymous format and hence will remain confidential.

Thank you for your help.

Project Coordinator  
Dan Fontenot  
Associate Specialist  
Louisiana State University

State Energy Coordinator

Code No. \_\_\_\_\_

A RESEARCH STUDY FOR DEVELOPING A CURRICULUM  
FOR IN-SERVICE TRAINING OF EXTENSION PROFESSIONALS  
ASSIGNED TO ENERGY CONSERVATION WORK

QUESTIONNAIRE

On the following pages you will find a list of concepts (Column II) which may be needed by Extension professionals engaged in energy conservation work. Each concept has been defined as to its intended meaning including components and/or examples to indicate subject matter content to be covered in the proposed in-service energy training curriculum.

Please rate in (Column I) the concepts as to the degree of necessity for including the concept in an in-service curriculum for training Extension professionals.

In (Column III), please indicate your cognitive ability (knowledge) concerning each concept.

Circle only one number (4, 3, 2, or 1) in Column I and only one number in Column III indicating your evaluation of each concept. The difference between the concept identified as being necessary for inclusion in an energy curriculum (Column I) and the knowledge competency of that concept (Column III) will establish the cognitive need or "gap" where in-service training is needed. The in-service curriculum developed to train Extension professionals in energy conservation will be taken from the identified needs.

Detailed instructions for completing the questionnaire are included on the next page at the beginning of Section I.

The success of the research study hinges upon your prompt and fair evaluation. Thank you for your help.

Please return the completed questionnaire to your state Energy Liaison Coordinator on or before October 15, 1981. Your state Energy Liaison Coordinator is:

(Note to Liaison person:) When all questionnaires are returned to you, please forward to:

Daniel Fontenot, Jr.  
Associate Energy Specialist  
LSU, Knapp Hall  
Baton Rouge, LA 70803  
Telephone # (504) 388-4141

SECTION I		
COLUMN I	COLUMN II	COLUMN III
Please rate the concept as to the degree of necessity that it be included in an in-service curriculum for training Extension professionals.	<p><u>CONCEPTS</u></p> <p>Listed are concepts which may be needed by Extension professionals doing energy conservation work. Each concept has been defined, including components and/or examples to be covered in the proposed in-service energy training curriculum.</p>	Please indicate your cognitive ability (knowledge) concerning each concept.
DEGREE OF NECESSITY FOR INCLUDING CONCEPT IN CURRICULUM	For each concept please circle the number that most appropriately expresses your feelings in Columns I & III.	YOUR KNOWLEDGE OF THE CONCEPT
4=Very Necessary 3=Necessary 2=Somewhat Necessary 1=Little or No Necessity	Energy Curriculum Development Study (1981)	4=Very Knowledgeable 3= Knowledgeable 2= Somewhat Knowledgeable 1=Little or No Knowledge

## CONCEPTS

4 3 2 1

(1) Refrigeration and Air Conditioning

Definition: Maintaining a space at a temperature below that of its surroundings including the equipment required to accomplish the job.

Components: Compressor, condenser, evaporator, expansion device, working fluid, fans, control, method of sizing, basic cycle, and load.

4 3 2 1



DEGREE OF NECESSITY	CONCEPTS	YOUR KNOWLEDGE
4 3 2 1	2) <u>Heating</u> <u>Definition:</u> Maintaining a space at a temperature above that of its surroundings including the equipment required to accomplish the task. <u>Components:</u> Heat pump, electric resistance elements, combustion process, and types of heating systems such as gas and oil, wood heating, coal, hot water and steam. Domestic hot water systems and safety aspects will be included in this section.	4 3 2 1
4 3 2 1	3) <u>Ventilation and Air Filtration</u> <u>Definition:</u> Supplying outside air and removal of inside air to provide satisfactory conditions including fans and duct work to provide forced circulation of air. Removing from the air undesirable contaminants such as dust, smoke, pollen and odors including equipment required to perform the task. <u>Examples:</u> Attic vent, duct leakage, vapor barrier, moisture problems, air handling, and types of filters.	4 3 2 1
4 3 2 1	4) <u>Lighting</u> <u>Definition:</u> The illumination of an area by either artificial or natural means, and equipment to accomplish the job. <u>Examples:</u> Lamp types, color index, dimmers, light efficiency, street lighting, daylighting and recommended illumination levels.	4 3 2 1
4 3 2 1	5) <u>Heat Transfer</u> <u>Definition:</u> The transfer of energy due to temperature differences including mass transfers involving temperature differences. <u>Components:</u> Conduction, radiation, convection, evaporation, heat capacity, phase change thermal storage and air infiltration.	4 3 2 1

4= Very Necessary  
3=Necessary  
2=Somewhat Necessary  
1=Little or No Necessity

4=Very Knowledgeable  
3=Knowledgeable  
2=Somewhat Knowledgeable  
1=Little or No Knowledge

4 3 2 1

6) First Law: Thermodynamics - Conservation of Energy

4 3 2 1

Definition: Energy is neither created nor destroyed; it is only changed in form. This yields the equation of: Energy in = Energy out + change of energy stored.

Example: A pot of water boiling on the stove uses 3 KWH of electricity but also puts 3 KWH of heat into the room, adding an additional cooling load of 3 KWH.

4 3 2 1

7) Second Law: Thermodynamics - Energy Quality

4 3 2 1

Definition: The amount of work which can be derived from a given quantity of energy. To determine the best use that can be made of a given amount and kind of energy, and to determine the limitations of how that energy may be used.

Example: Electrical energy could be used to heat water by resistance heat. However, a better use would be to power a motor, then run a heat pump and get 2 or 3 times as much hot water for the same amount of energy.

4 3 2 1

8) Pricing Structure

4 3 2 1

Definition: The component parts of utility bills and the rationale behind each component

Example: Fuel adjustments, demand charges, minimum charges and incremental rates.

DEGREE OF NECESSITY	CONCEPTS	YOUR KNOWLEDGE
4 3 2 1	9) <u>Building Design and Construction</u> <u>Definition:</u> The design and construction of buildings with attention to aspects which affect energy consumption. <u>Components:</u> Orientation, order in which houses or buildings are constructed, building envelope or shell, new construction and retrofit options and limitations, components such as windows, doors, roof, walls, fireplaces, insulation, weatherstripping and caulking; innovative houses, passive solar techniques, and standard housing types such as mobile homes.	4 3 2 1
4 3 2 1	10) <u>Payback Analysis</u> <u>Definition:</u> A method of determining if an energy conservation measure is economically feasible. <u>Components:</u> Simple payback, tax credits, equipment life expectancy, life cycle costing and financial incentive programs.	4 3 2 1
4 3 2 1	11) <u>Psychrometrics</u> <u>Definition:</u> A study of the relationship between wet and dry bulb temperatures and its bearing on the amount of water vapor in the air. <u>Components:</u> Humidity, relative humidity, dehumidification, dewpoint, temperature, psychrometric chart.	4 3 2 1
4 3 2 1	12) <u>Transportation and Power Vehicles</u> <u>Definition:</u> The operation and maintenance of power-driven vehicles as related to energy conservation. <u>Components:</u> Automobiles, tractors, engine types (diesel, gasoline), gas-saving measures, transmission efficiency, horsepower, body design, EPA rating, tires, fuel types and quality, and electric systems.	4 3 2 1

4=Very Necessary 3=Necessary 2=Somewhat Necessary 1=Little or No Necessity						4=Very Knowledgeable 3= Knowledgeable 2=Somewhat Knowledgeable 1=Little or No Knowledge			
4	3	2	1	13)	<u>Control Systems</u> <u>Definitions:</u> Systems of devices and controls integrated to govern the operation of the energy-consuming equipment, particularly heating, ventilating, and air conditioning systems. <u>Example:</u> Thermostat, demand controller, air conditioning control systems, and time clocks.	4	3	2	1
4	3	2	1	14)	<u>Comfort and Environmental Factors</u> <u>Definition:</u> The physiological and psychological factors influencing a person's perception of a comfortable condition. <u>Example:</u> Furniture color, textile and placement, clothing, humidity, and air movement.	4	3	2	1
4	3	2	1	15)	<u>Energy Management Program</u> <u>Definition:</u> The management of energy conservation programs. <u>Components:</u> Energy audits, design of efficiency in equipment and appliances, operation and maintenance, and standards and labeling of major appliances.	4	3	2	1
4	3	2	1	16)	<u>Energy Measurements</u> <u>Definitions:</u> Instrumentation and methods used in measuring quantities of energy. <u>Examples:</u> Electric and gas meters, thermometer, light meter, velometer, infrared meter.	4	3	2	1

DEGREE OF NECESSITY				CONCEPTS	YOUR KNOWLEDGE			
4	3	2	1	17) <u>Food Processing</u> <u>Definition:</u> Food processing practices and their relationship to energy uses. <u>Examples:</u> Cooking, canning, freezing, storage, purchase, waste and transportation of food.	4	3	2	1
4	3	2	1	18) <u>Agricultural Production Practices</u> <u>Definition:</u> Production practices in agriculture and their relationship to energy use. <u>Examples:</u> Minimum tillage, fertilization, irrigation, pesticides, herbicides, soil erosion, crop drying, greenhouses, poultry, animal production, field crops and fruit production and gardening.	4	3	2	1
4	3	2	1	19) <u>Landscaping</u> <u>Definition:</u> The arrangement of plantings and structures to promote energy conservation. <u>Examples:</u> Trees, shrubs, turf and ground cover.	4	3	2	1
4	3	2	1	20) <u>Energy Recovery</u> <u>Definition:</u> To recover energy from waste materials and discharges, recyclable products. <u>Examples:</u> Waste heat recovery, solid waste, recycling such as glass, steel, paper and aluminum.	4	3	2	1
4	3	2	1	21) <u>Production of Energy</u> <u>Definition:</u> The production and amount of reserves for: oil, natural gas, coal, hydro-electric, nuclear and alternate energy sources such as solar, wind, ocean, biomass, methane, alcohol, and wood.	4	3	2	1

4=Very Necessary 3=Necessary 2=Somewhat Necessary 1=Little or No Necessity					4=Very Knowledgeable 3=Knowledgeable 2=Somewhat Knowledgeable 1=Little or No Knowledge				
4	3	2	1	22)	<u>Energy Costs, Trends and Environmental Effects</u> Definition: The cost of energy from both monetary and environmental standpoints and the effect that consumption trends would have on these costs. Components: U.S. consumption vs. world, future energy consumption and cost expectations, cost of various forms of energy in terms of dollars, environment, land use and economy, and the effect of the exponential increase (doubling time) on these factors.	4	3	2	1
4	3	2	1	23)	<u>Energy Conservation and Quality of the Environment</u> Definition: The care or preservation of natural resources such as water. Example: Western coal or oil shale requires large quantities of water for energy conservation.	4	3	2	1
4	3	2	1	24)	<u>Terminology</u> Definition: Technical or special terms used in energy conservation work. Examples: BTU, COP, demand billing, demand control, efficiency, EER, foot candle, foot-pound, heating value, horsepower, CCF, KW, KWH, cooling load, lumens, MPG, MPH, U-value, power factor, R-value, SEER, standard cubic foot, thermal efficiency and watt.	4	3	2	1

## SECTION II: GENERAL INFORMATION

1. Name \_\_\_\_\_  
First M.I. Last
2. State \_\_\_\_\_ 3. Age \_\_\_\_\_  
Years

4. Sex: Male Female

5. What degrees have you earned, and what were the major and minor field of study for each degree?

	<u>Check</u>	<u>Major Field</u>	<u>Minor Field</u>
1. BS	_____	_____	_____
2. MS	_____	_____	_____
3. PhD/ EdD	_____	_____	_____

6. How many years have you been employed in:

Years

1. Extension Work \_\_\_\_\_
2. Extension Energy Work \_\_\_\_\_
3. Other Work \_\_\_\_\_

7. What is your present job title?

8. Is your assignment at: (check one)

1. State Office \_\_\_\_\_
2. Multi County \_\_\_\_\_
3. County \_\_\_\_\_
4. Other (list) \_\_\_\_\_

9. What percentage of your time do you devote to energy work? \_\_\_\_\_  
(percent energy)

10. Please indicate your race.

White , Black , Asian , American/Indian , Other .

Thank you for taking time to complete this questionnaire.

APPENDIX B  
LSU - EDUCATIONAL BACKGROUND CATEGORIES



LOUISIANA STATE UNIVERSITY'S  
CATEGORIES FOR EDUCATIONAL BACKGROUND  
PREPARED BY THE LSU GRADUATE SCHOOL

<u>Bioscience</u>	<u>Humanities</u>	<u>Physical Sci.</u>	<u>Social Sci.</u>
Agronomy	English	Agr. Engr.	Accounting
Animal Science	Fine Arts	Biochemistry	Agr. Econ.
Botany	Foreign Lang.	Chem. Engr.	Bus. Fin. & Stat.
Dairy Science	History	Chemistry	Economics
Entomology	Journalism	Civil Engr.	Education
Food Science	Landsc. Arch.	Elec. Engr.	Ext. Education
Forestry & Wildlife	Linguistics	Engr. Sci.	Geog. & Anth.
Horticulture	Music	Geology	Government
Marine Science	Philosophy	Math	HP & RE
Microbiology	Speech	Mech. Engr.	Home Econ.
Plant Pathology		Inds. Engr.	Libr. Science
Poultry Science		Nucl. Engr.	Mgt. & Mkt.
Psychology		Petro. Engr.	Sociology
Zoology & Physiology		Physics	Voc. Ag. Educ.
Vet. Med. Science			Latin Amer. Studies
			Business Admin.
			Quantitative Method

## VITA

Daniel Fontenot, Jr. was born on May 1, 1930 near Church Point, Louisiana. He attended parochial school and also one year of high school in Church Point, Louisiana, and graduated from Lawtell High School, Lawtell, Louisiana in 1948.

He entered Louisiana State University and received the degree of Bachelor of Science in Dairy Husbandry and was also commissioned an officer in the United States Air Force in 1953. He then worked with Borden's Creamery in Baton Rouge, Louisiana, for a short period before serving as an aircraft maintenance officer in the Air Force from April, 1953 until he was honorably discharged as a first lieutenant in June, 1956.

He joined the Louisiana Cooperative Extension Service in 1956. His tenure there has been continuous from that date to the present. He has served in Pointe Coupee Parish as 4-H club agent, in St. James Parish as county agent and sugarcane area agent, and finally as Associate Specialist (4-H) with energy conservation education responsibility for 4-H agricultural literature--the position he presently holds. He received the Master of Science degree in Extension Education from Louisiana State University in 1963 and is currently a candidate for the Doctor of Education degree in Extension Education.

He is married to the former Louise Thibodeaux. They have one son, Danny.

## EXAMINATION AND THESIS REPORT

Candidate: Daniel Fontenot, Jr.

Major Field: Extension Education

Title of Thesis: A Curriculum for Training Extension Professionals in Energy  
Conservation Education

Approved:

*Edward W. Gassie*

Major Professor and Chairman

*William Cooper*

Dean of the Graduate School

### EXAMINING COMMITTEE:

*J. David Bankston, Jr.*

*Bruce Hunt*

*Joe E. Seabury, Jr.*

*Earl Barrios*

*Leticia Venna*

Date of Examination:

March 31, 1982